# Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.


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Minimis partibus, per totum Naturæ campum, certitudo omnis innititur
quas qui fugit pariter Naturam fugit.—*Linnæus.*

FOR THE YEAR

1903


TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, LONDON, W.

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# MICROSCOPY.

## A. Instruments, Accessories, &c.*

### (1) Stands.

**New Binocular Microscope.**†—F. E. Ives, after an enumeration of the inconveniences which render the ordinary binocular unsuited for high-power work, describes one of his own invention, which has the following advantages:—(1) It is a short-tube Microscope; (2) The parts which make it a binocular may be attached to an ordinary Microscope without alteration; (3) It is not an expensive attachment; (4) It does not interfere with the use of the Microscope as a monocular with variable tube-length; (5) It may be used either as a binocular non-stereoscopic Microscope, or as a binocular stereoscopic Microscope; (6) As a non-stereoscopic binocular, it sends to both eyes images practically identical with the single image of a monocular, no diffraction pencils being cut off from either image, and it is as satisfactory with the highest as with the lowest powers, dividing the work evenly between the two eyes even when doing the most critical work; (7) As a stereoscopic binocular, it yields to both eyes images distinctly more perfect than either image in a Wenham binocular, and, while giving true stereoscopic relief with medium and low powers, never exaggerates this effect, as the Wenham binocular sometimes does. As against these advantages may be placed the fact that it requires a little more skill to adjust it than the Wenham binocular; but it should not be at all troublesome to the

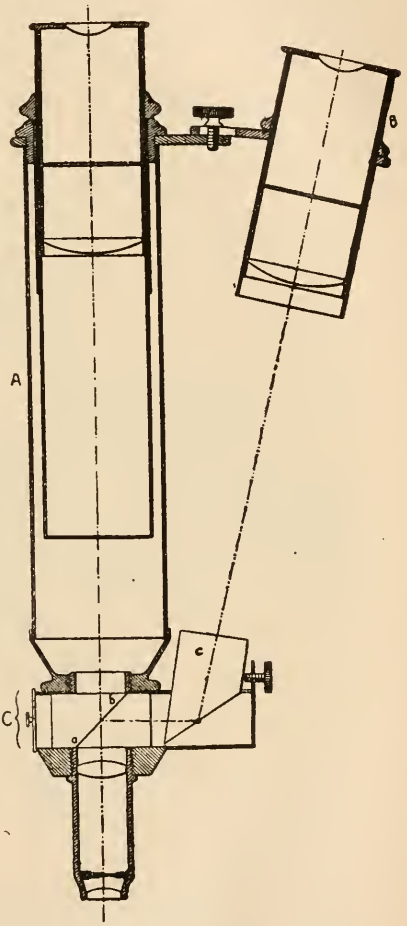



Fig. 3.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Journ. Franklin Inst., cliv. (1902) pp. 441-5 (1 fig.).

expert microscopist. In fig. 3 are shown the two attachments which effect this change in an ordinary Microscope:—(1) a small prism-box with Society screw to fit the lower end of the Microscope-tube; and (2) an attachment to the upper end of the tube to carry the second eye-piece, with means for adjustment to suit different pupillary distances. The prism-box C contains one compound cemented prism, with transparent silvering on one of the inner faces *a b*, and a single prism *c*. The dotted lines show the path of the axial ray, one half of which is transmitted through the compound prism, and the other half reflected into the prism *c*, and thence to the auxiliary eye-piece. The body of the prism *c* is extended in the direction of the eye-piece for the purpose of making the optical length of both axial rays alike, so that matched eye-pieces may be used. There are three ways of changing from binocular non-stereoscopic to stereoscopic vision. The first consists in covering a portion of the top of the compound prism by a little metal slide. The other two methods depend upon the fact that decentring the eye-points is equivalent to covering opposite sides of the back of the objective. Hence, if the eye-points are brought about one-eighth of an inch closer together than the observer's pupillary distance, stereoscopic vision is secured; if they are separated by such an amount, then pseudoscopic vision results. With low-power objectives and two-inch eye-pieces one may arrange the distance so that, by slightly varying the plane of the eye-points, one may have stereoscopic, non-stereoscopic, or pseudoscopic vision at pleasure, and without moving the eyes far enough to lose any of the field of view. With high-power objectives, the entire field is seen perfectly only when the instrument is adjusted for non-stereoscopic vision with the eyes in the plane of the eye-points.

**Watson and Sons' Metallurgical Microscope.***—This Microscope (fig. 4) has been constructed exclusively for the examination of metals and minerals, and is of the best quality throughout. The coarse and fine adjustments do not present any novelty. The body is of large diameter, and the draw-tube can be arranged to carry either the Continental or large-sized (1·27-in.) eye-pieces, as may be preferred. When the draw-tube is closed the body-length is 152 mm.; when extended, 250 mm. The stage has mechanical screws, and in this respect resembles the "H" Edinburgh Students' Microscope, made by the same firm. In the centre of the stage is a cylindrical fitting, into which super-stage plates may be fitted and interchanged. The illustration shows a super-stage plate, with levelling-screws for the purpose of adjusting the planes of specimens under examination, so as to get them perpendicular to the optical axis. The upper surface of this super-stage is higher than the milled heads controlling the mechanical movements, so that large blocks of metal can be freely moved on the stage. The top-plate measures 3½ by 2½ in., and can be readily removed and replaced by a metal-holder, in which blocks of metal can be held at any angle, or rotated. A rackwork of strong, though very smooth and precise construction, is fitted to the stage, and permits it to be moved up and down for focussing after the lighting adjustment has been made. A vertical illuminator, with disc of cover-glass, is provided with the

* W. Watson & Sons' Catalogue, 1902–3, p. 78.

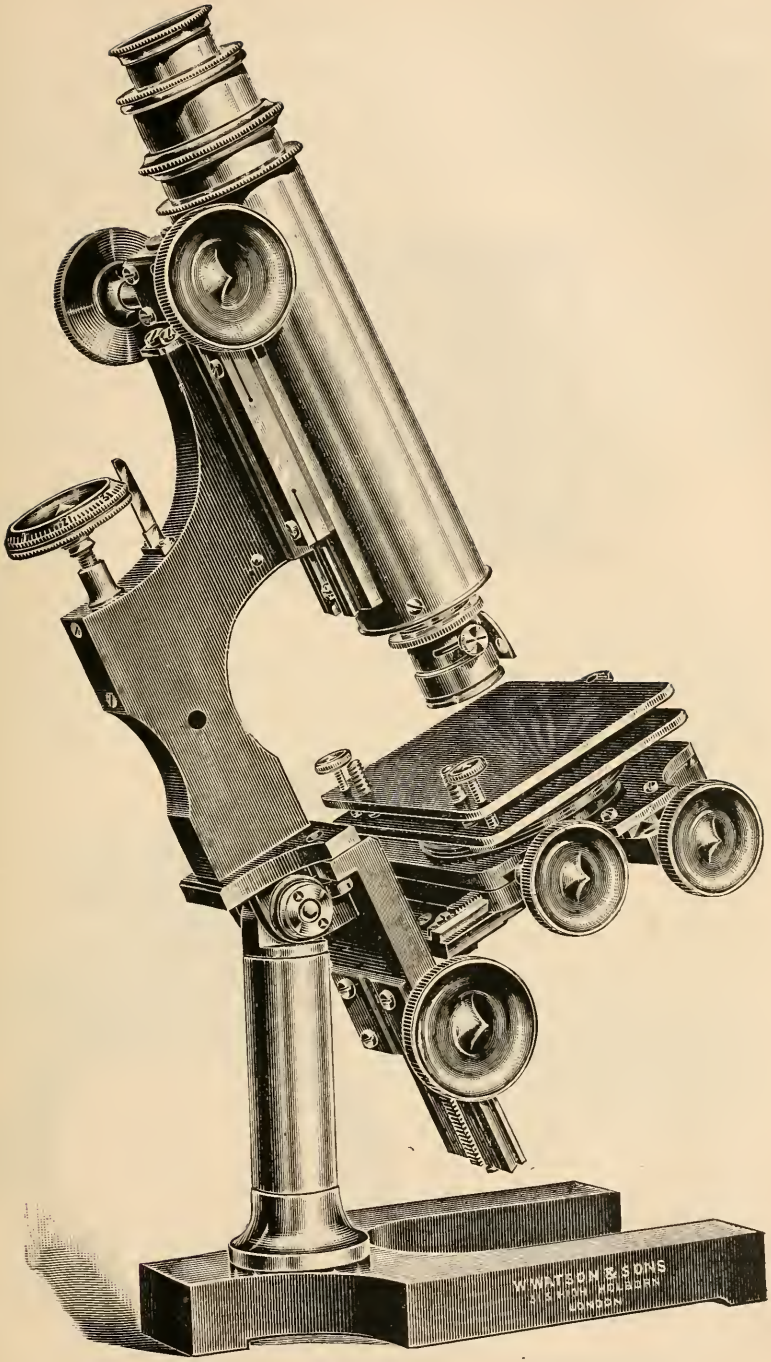



Fig. 4.

instrument, and may be fitted either at the top of the body-tube, or at the lower end, as figured.

**Watson and Sons' Museum Microscope.***—This instrument (fig. 5) has been designed especially for the use of students who may be pursuing some particular branch of study, or for visitors to museums. It

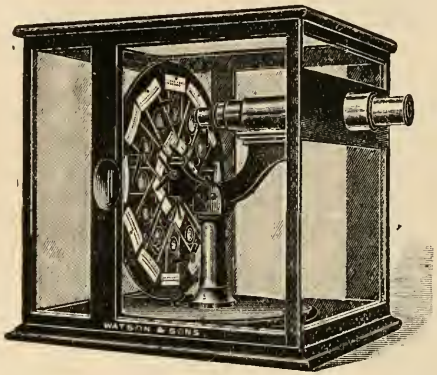



Fig. 5.

consists of a dust-proof mahogany-framed glass case, in which the Microscope is fitted. The objects, 12 in number, are mounted upon a disc, which can be rotated from outside the case. The eye-piece of the Microscope also projects outside the case, and focussing is effected by means of a milled head, actuating a rackwork-and-pinion on the right-hand side of the case.

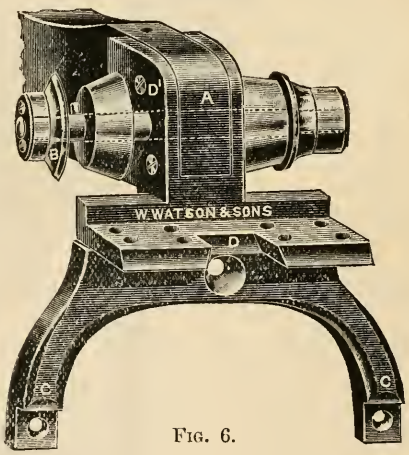



Fig. 6.

**Method of Fitting the Stage and Limb of Watson's Van Heurck Microscope.†**—In this instrument the contrivance (fig. 6) for connecting the limb, stage, and substage is especially calculated to ensure rigidity of the whole Microscope. The limb A is fitted into the sub-stage bracket-plate D, which is held firmly by screws; the joint-bolt B goes through the whole—limb and stage-bracket—rendering the limb, stage, and substage as firm as if they were one piece. This stage-bracket C C, instead of being screwed to the front of the limb, as is usually done, is made in a solid casting; it takes the substage beneath on the plate D, and goes right *into* the joint at the top of the pillar. The

* W. Watson & Sons' Catalogue, 1902–3, p. 77. † Tom. cit., p. 61.

makers consider that the strength and freedom from spring obtained by these arrangements are unique in Microscope construction, and that the method is altogether superior to that of connecting the parts solely by screws.

**Watson and Sons' Attachable Mechanical Stage.***—The special feature of this stage (fig. 7) is that it can be immediately fixed to a Microscope without any special fitting. It is placed upon the stage, and grips upon the edges like an ordinary sliding-bar; it is then clamped in position by means of a thumb-screw. It has a long range of movement in both horizontal and vertical directions.

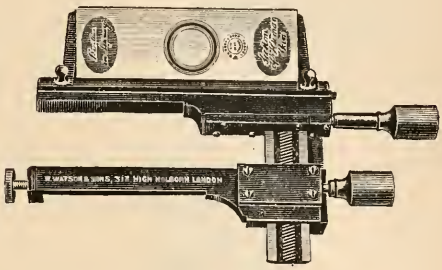


Fig. 7.

**Portable Class-Microscope.†** This Microscope (fig. 8) is intended for the use of classes studying botany, zoology, &c. It is of German make, and though not of recent date, has points of interest. The body slides in an outer tube, which has an expanded foot containing a Lieberkuhn 2½ in. diameter, and an arrangement for holding a slide in front of it. The object is viewed by holding the instrument towards the light. The objective is separable into three parts, forming powers with magnifications of 44, 96, and 130 diameters. In order to focus an object, the screw-collar on the outer tube is

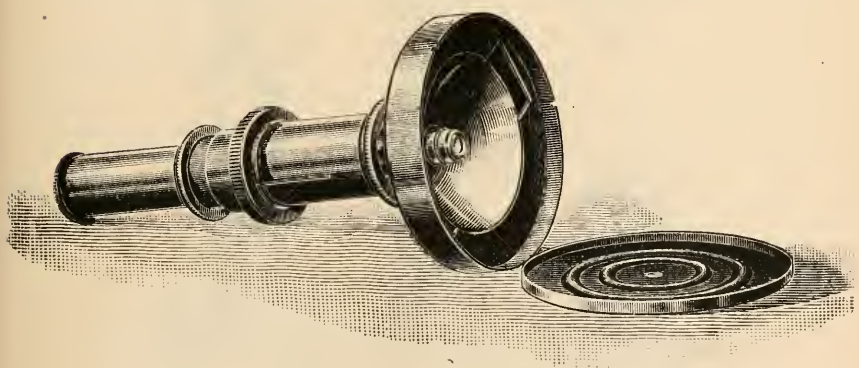


Fig. 8.

slackened, and when the focus is obtained, the collar is tightened. A cap with a small hole in the centre is provided for the protection of the Lieberkuhn, and when more than one lens is used the cap is employed, and acts as a diaphragm when transparent objects are examined.

* W. Watson & Sons' Catalogue, 1902–3, p. 81.

† Exhibited at the October Meeting, 1902. See this Journal, 1902, p. 622.

**Barbour's Pocket Microscope.***—This is also primarily intended for field geologists, and is small enough to be carried in the vest pocket, the entire size being scarcely larger than an objective-case. A, fig. 9, shows the instrument open ; B, shut. C is a lens-case for comparison as to size. The following magnifications are obtained, viz. 100, 60, 40, 30, 20, and 15 diameters, which are amply sufficient for field work.

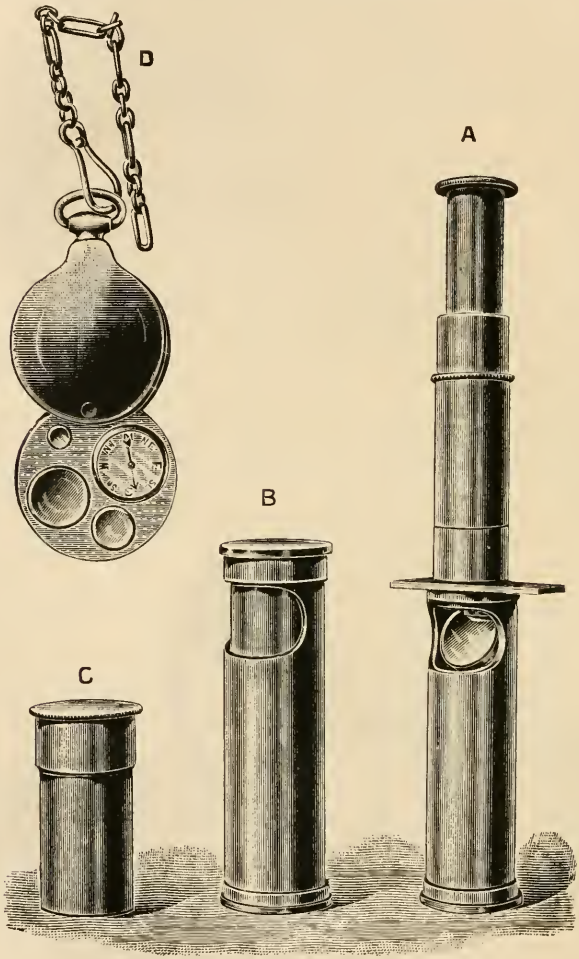



Fig. 9.

Régaud, Cl., et Nachet, A.—**Une nouvelle monture de microscope munie d'une platine mobile repérable à mouvements très étendus.**
*Arch. d'Anat. Microsc.*, V., fasc. 1 (1902) p. 17.

Régaud, Cl.—**Nouveau microscope pour l'étude des coupes en séries.**
*Comptes Rend. Assoc. des Anatomistes*, 3, Lyon, 1901, p. 262.

* Journ. App. Micr., v. (1902) pp. 1963–5 (1 fig.).

SCHEFFER, W.—**Das Mikroskop, seine Optik, Geschichte und Anwendung.**
Leipzig (Teubner), 8vo, 114 pp. and 66 figs.

THON.—**Ein neues Trichinenmikroskop.**
*Deutsche Thierärztl. Wochenschr.*, 1902, No. 8, p. 74.

WOLFFHÜGEL, K.—**Ein neues Trichinenmikroskop.**
*Zeit. f. Fleisch- u. Milchhyg.*, 1901–2, H. 3, p. 78.

### (2) Eye-pieces and Objectives.

**Barbour's Pocket Magnifier.***—This little instrument (D, fig. 9) is primarily intended for the field geologist, and is made by Messrs. Bausch and Lomb. The inventor's idea was to design a pocket magnifier which should fit in the vest pocket like a small flat watch, free from angles and corners. It contains Hastings' triplets of 5, 10, and 20 diameters, together with a compass. If desired, the compass could be omitted, and the size thereby reduced.

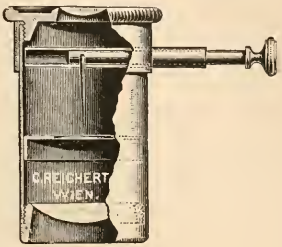



FIG. 10.

**Bourguet's New Index Ocular.**†—This ocular (fig. 10) contains a pointer, adjustable from outside, by means of whose point every spot of the field of view can be indicated. It is especially adapted for giving students of histological and bacteriological classes definite information about any part of the microscopic field.‡

**Französische Mikroskope.**
[An account of progress recently made by French opticians in the manufacture of objectives.]
*Central. Ztg. f. Opt. u. Mech.*, XXIII. (May 1902) p. 98.

HARTWICH, C.—**Ueber ein paar Mikroskopoculare mit Messvorrichtung.**
*Centralztg. f. Opt. u. Mech.*, XXIII. (1902) p. 11.

MALASSEZ, L.—**Sur les oculaires à glace micrométrique et à usages multiples.**
*Arch. d'Anat. Microsc.*, IV., fasc. 2, 3 (1901) p. 219.

MCGREGOR-ROBERTSON, J.—**Ehrlich's Eye-piece for the Differential Count of Red and White Corpuscles in Stained Films.**
*Glasgow Med. Journ.*, LV. (1901), No. 5, p. 339.

SCHAFFNER, J. H.—**Oculars for General Laboratory Work.**
*Journ. App. Micr.*, V. (1902) p. 1646.

### (3) Illuminating and other Apparatus.

**Watson and Sons' Macro-Illuminator.**§—This is a single achromatic combination of $1\frac{1}{4}$ in. clear aperture and 2 in. focus. It excels in producing a brilliant and uniform illumination of large objects under low powers. The lens is mounted to fit into the substage, close to the object, so as to focus the image of the source of light on the objective. Objects up to fully 1 in. in diameter may be thus illuminated with absolute uniformity. It is extremely valuable for photography with the holostigmat and planar types of lenses.

* Loc. cit.
† Zeitschr. angew. Mikr., viii. (1902) p. 33 (1 fig.).
‡ This ocular is a reinvention of Quekett's indicator eye-piece (1848).
§ W. Watson & Sons' Catalogue, 1902–3, p. 99.

**Watson and Sons' Incandescent Gas Lamp.***—This lamp is shown in fig. 11. It has an incandescent burner, with by-pass, mica chimney, and metal hood. An iris diaphragm may be fitted in the hood, so that the diaphragm aperture may be used as the light-source, and the mantle structure eliminated.

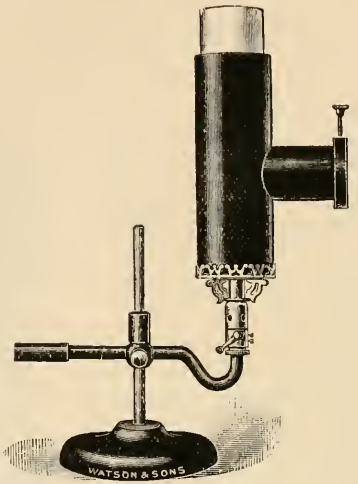



Fig. 11.

**Dr. G. Johnstone Stoney's Improved Heliostat.**†—Messrs. Watson have constructed this instrument (fig. 12) under the designer's super-

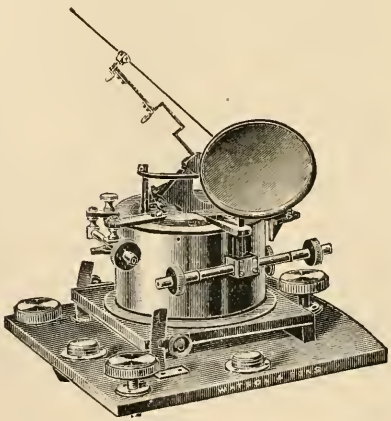


Fig. 12.

vision, and the improvements effected in it render it more than ever suited to the requirements of the physicist and photomicrographer. It

* W. Watson & Sons' Catalogue, 1902-3, p. 116. † Tom. cit., p. 106.

is mounted on a stout mahogany base, provided with levelling-screws and spirit-levels. The lever clockwork movement is of first-rate quality, and a fine adjustment for precisely setting the position of the instrument is afforded by a rackwork-and-pinion and tangent-screw. The mirror is parallel-worked, of fine quality.

**Method of Using Abbe's Apertometer.*** — F. J. Cheshire points out that the method of using Abbe's apertometer with a lamp-edge, as given by Dallinger,† is open to an error if the lamp is put too near, and if it be assumed that the centre $o'$ (fig. 13) of the focussing disc is also

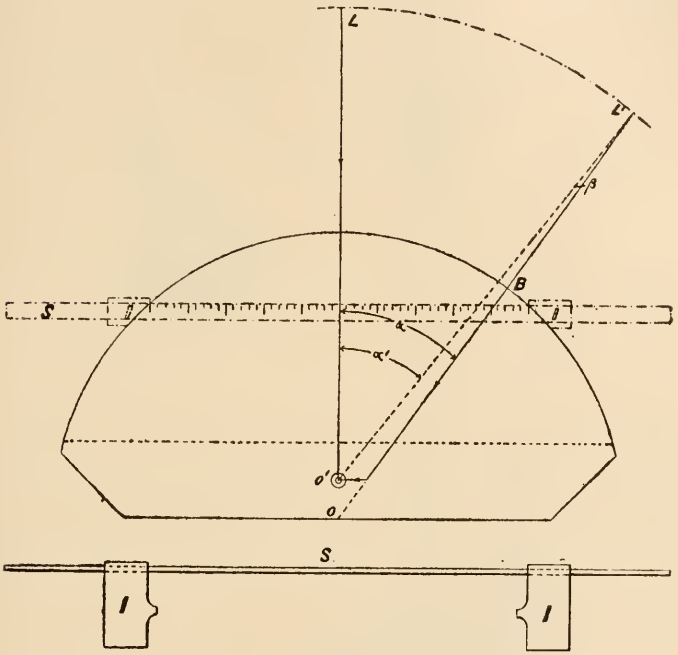



Fig. 13.

the centre of the circular edge of the apertometer; in reality this latter point is $o$, the middle of the chord. Let this distance $o\,o'$ be $d$, and the distance from $o'$ to the lamp L be D. Describe a circle with $o'$ as centre, and $o'$ L as radius. Suppose the adjustments made so that $\alpha'$ is the semi-angle as usually taken, $\alpha$ the true semi-angle, so that $\alpha = \alpha' + a$ small angle $\beta$. Then it can be shown that the numerical aperture (as found) = true numerical aperture $+ \frac{\mu\, d \cos \alpha \sin \alpha}{D}$. This last term $= \frac{\mu\, d \sin 2\alpha}{2\,D}$, and will have a maximum when $\alpha = 45°$, i.e. for N.A.'s

* Journ. Quekett Micr. Club, Nov. 1902, pp. 349–52 (1 fig.).
† Dallinger-Carpenter, 8th ed., pp. 394–5.

just over unity. If the lamp is set near the instrument, so that D is small, the error may become 10 p.c. The lamp should be at least a foot away when the error sinks to 1 or 2 p.c.

**Simple Method of Focometry and Apertometry.***—F. J. Cheshire first shows how Abbe's method † of determining the focal length of an optical system can be conveniently applied to a Microscope objective. The magnifying power of the objective is first determined with the draw-tube pushed in. This may be done by placing a sheet of ground glass on the top of the draw-tube, from which the eye-piece has been removed, and then focussing and measuring the image of a stage-micrometer upon it. The magnification M having been determined by this or any other method, the draw-tube is then pulled out to its full extent, and the magnification M again found. Let $\delta$ equal the amount of draw-tube extension, then the focal length $f$ of the objective system $= \frac{\delta}{M' - M}$.

The author also gives allied ways of determining the focal and

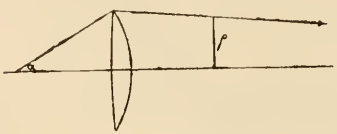



Fig. 14.

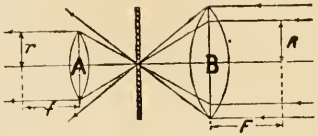



Fig. 15.

principal points of objectives, eye-pieces, &c., and optical tube-lengths. His methods of apertometry depend upon the following theory:—In the case of an aplanatic Microscope objective (fig. 14), let $\alpha$ equal the semi-angle of the maximum cone of light which it can take up from an object in a medium of refractive index $\mu$, and let $\rho$ equal the radius of the disc of light in the upper focal plane. By a well-known equation, if $f$ equal the back or upper focal length, the N.A. $= \mu \sin \alpha = \frac{\rho}{f}$. Now consider the two lens-systems A and B (fig. 15) with a common focal plane and parallel incident light. Further, suppose that each system is spherically corrected for light converging to the common focal points. The system B is shown transmitting a cone of light of greater N.A. than the system A can take up. The effective and equivalent semi-apertures are R and $r$ respectively, and for these the N.A.'s must obviously be equal. Thus $\frac{r}{f} = \frac{R}{F}$ or $\frac{R}{r} = \frac{F}{f}$ = a constant. The author describes how, by use of an Abbe's two-lens chromatic condenser and a disc of fine wire-gauze, he takes the necessary measurements. He also gives a comparative table of N.A.'s of a series of lenses obtained by Abbe's apertometer and by the above method. The two sets of results closely agree.

* Journ. Quekett Micr. Club, Nov. 1902, pp. 331–42 (6 figs.).
† This Journal, 1892, p. 427.

**Watson's New Standard Electric Lamp.***—This lamp (fig. 16), which is intended for Microscope work, has a 16 candle-power incandescent burner, with frosted glass bulb. It is carried on a lacquered brass standard, and, by means of a movable double arm, is adjustable in all directions. The bulb is inclosed in a nickelled reflector of parabolic shape, which has the simultaneous advantage of shielding the eyes and concentrating the light on the Microscope mirror. It can also be supplied with a special hood and iris diaphragm.

Fig. 16.

**Small Electric Light for Photomicrography.†**—W. Scheffer's first experiments were with a cravat-pin, which held a small electric lamp, lighted by a dry cell of American make. He then constructed a small lamp (fig. 17), in which the carbon filament lay as near as possible to the glass, so that the whole lamp might be brought into close proximity to the under side of the object-slide. The filament, magnified ten diameters, is shown more completely in fig. 18. The length of the filament (*a*, fig. 17) is 1 mm., the thickness 0·1 mm., and

* W. Watson & Sons' Catalogue, 1902–3, p. 116.
† Zeitschr. wiss. Mikr., xviii. (1902) pp. 405–8 (3 figs.).

the distance from the object O 2·5 mm. The cone of rays, seen broadside, is shown in I. (fig. 18), and end-on in II., B being the base (i.e. *a* in fig. 18). In III. is represented a cone of rays proceeding from a base 2·5 mm. under similar conditions; the vertical angle of the cone

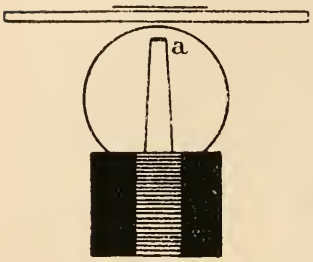



Fig. 17.

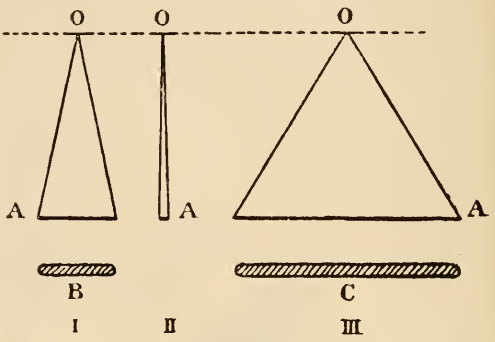



Fig. 18.

is obviously much more obtuse. This latter form is to be recommended for objectives of high aperture, and for objects visible by absorption (e.g. coloured preparations), the narrow filament being better for objects affected merely by refraction (e.g. diatoms, uncoloured preparations, &c.).

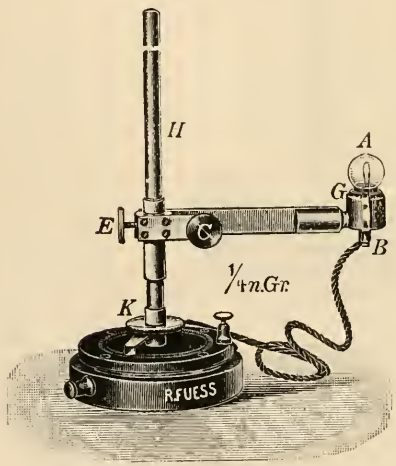



Fig. 19.

When the lamp is brought right under the object, a drop of cedar-oil will bring lamp and object-holder into close connection, and thereby much increase the effect of the light.

The lamp is supported on a stand (fig. 19) by means of an arm F, clamped by a screw E. The heavy foot-plate is also a resistance-block, and has a contact-key K, thus allowing any desired brightness of light to be obtained. The arm F has a lateral motion by means of the spring C, whereby the position of most advantageous oblique illumination may be found. In G the lamp may be rotated and clamped for application with the vertical illuminator. The holder B is so fitted with contact-springs that the lamps have merely to be inserted. The resistance-block is provided with a divided circle, so that the degree of illumination can be always regulated. An accumulator is recommended as a light-source. Among other advantages possessed by the apparatus, such as cheapness, simplicity, and constancy,

is the shortness of time-exposure, so that no condenser system is required.*

**Illumination, and the Use of the Condenser in Histological Micrography.**†—A. B. Lee sums up his paper on this subject with the following advice :—"If you desire to work with daylight, which I do not advise, put an object on the slide, turn the mirror so as to illuminate it, focus, centre the condenser, if it is not already centred for the objective to be used, set the diaphragm, and focus the condenser on a bar of the window. Afterwards never touch the diaphragm, nor the condenser rackwork.

"If you desire to use a lamp without bull's-eye, put it exactly in its marked position on the table, turn the edge of the flame towards the Microscope, put a coloured screen in front, turn the plane mirror so as to illuminate the condenser, centre the condenser, orientate the mirror so as to centre the flame-image, set the diaphragm, and focus the condenser. Afterwards never touch the diaphragm or the condenser, but regulate the light, if necessary, by your coloured screens.

"If you desire to use the bull's-eye, which I regard as the normal arrangement for a cytologist, proceed at first exactly as above, then place the bull's-eye before the flame. Its focal distance from the flame and its azimuthal position having been once for all fixed by stop-screws, it will be in adjustment as soon as it fully illuminates the mirror, and it will be only necessary to slightly correct the orientation of the latter for getting the exact centring of the flame-image, and to re-focus the condenser for its new light-source. As before, never afterwards touch the diaphragm nor the condenser rackwork, but regulate the light, if necessary, by coloured screens."

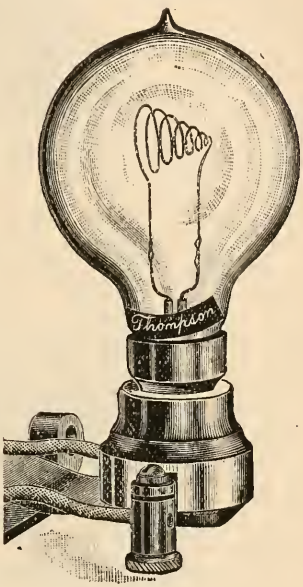



Fig. 20.

**Illuminating Apparatus for Metallography.**‡—1. *Electric Incandescent Lamp.*—This is shown in fig. 20, and is of 150 candle-power, with Edison base, socket, binding-posts, stand, and elevating-screws. It is used with a large biconvex condensing lens.

2. 90° *Automatic Focussing Electric Arc Lamp.*§—This (fig. 21) is used for projection or for photomicrography. It yields from 2000 to

* This method of illumination for visual purposes was exhibited before the Society, January 1883; it proved a complete failure, the definition being such as would satisfy no one but the merest beginner, *Journ. R.M.S.*, 1883, p. 29, figs. 1–6. It was reinvented in 1885 and 1886, v. *Journal* for those years, p. 303, figs. 48–54, and p. 1053, fig. 222.

† La Cellule, xix. 2nd fasc. (1902) pp. 405–31 (1 pl.); also as a pamphlet.

‡ Catalogue of the Boston Testing Laboratories, p. 16, fig. 14.

§ Loc. cit., pp. 16–8, fig. 16.

4000 candle-power, and is adapted to both direct and alternating currents. It is enclosed in a nickel-plated light-tight hood.

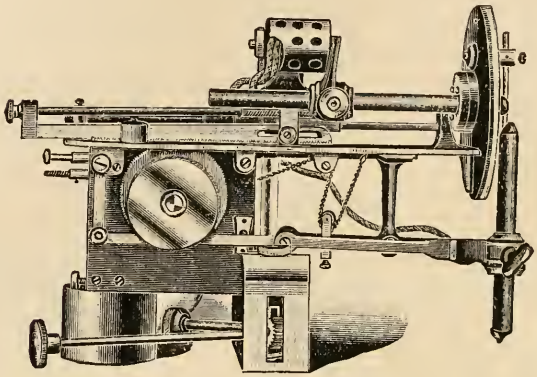


Fig. 21.

3. 90° *Hand-fed Electric Arc Lamp.**—This (fig. 22) is for exactly the same purpose as the last.

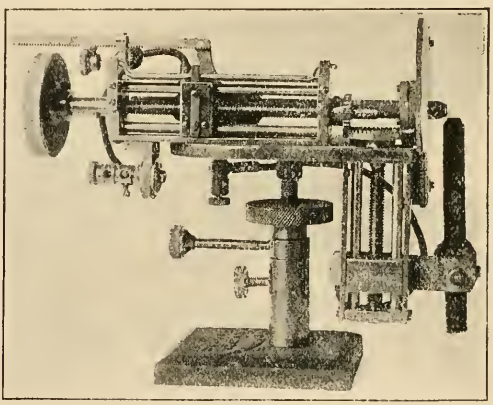


Fig. 22.

4. *Acetylene Gas Apparatus.*†—This illuminant is considered inferior to electricity. The arrangement of burners is shown in fig. 23, and the generator in fig. 24. They are coupled by india-rubber tubing.

* Loc. cit., fig. 17.

† Loc. cit., p. 19, figs. 18 and 19.

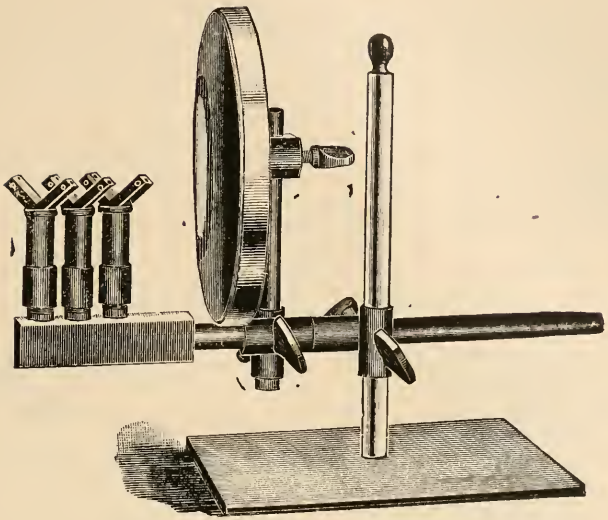


Fig. 23.

**Origin of the Davis Shutter.**—It will be found, on referring to the *Journal* for 1882, p. 262, that an iris diaphragm placed at the back of an object-glass (now known as a Davis shutter) was first suggested by Dr. Royston Pigott in 1869, for reducing the aperture of objectives. At that date Dr. R. Pigott maintained that wide-aperture objectives produced confused images.

**Simple Form of Reflecting Polariser.*** — F. J. Cheshire mounts, in the axis of the Microscope, a slip of ground glass G (fig. 25), about $1\frac{1}{4}$ by $2\frac{1}{2}$ in., at an inclination of $33\frac{1}{2}°$, on a short spindle A, capable of rotation by a milled head B. The glass slip is blackened with Aspinall's enamel on its back and ground side. This polariser is mounted on the tail-piece of the Microscope in the same way as the usual mirror. Therefore when the spindle A has been rotated so as to bring the lamp-flame into view, the light is reflected at the proper angle

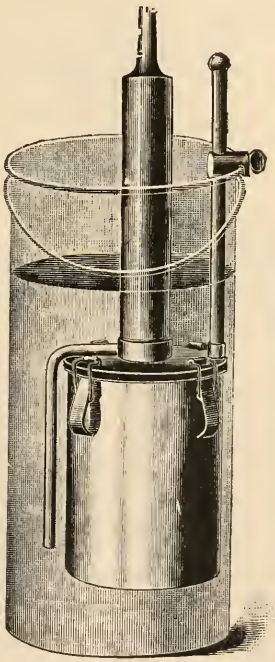


Fig. 24.

* Journ. Quek. Micr. Club, Nov. 1902, pp. 353–4 (1 fig.).

for polarisation. The analyser is screwed into the bottom of the draw-tube, in which position it does not limit the field of view as when mounted in the eye-piece, and must be capable of independent rotation.

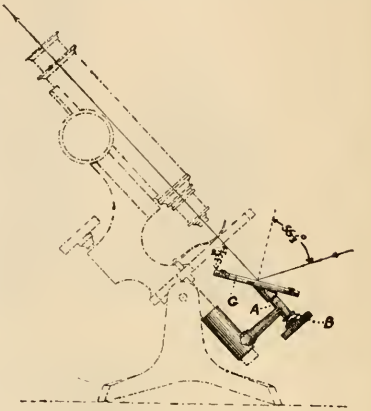



Fig. 25.

Leiss, C.—**Ueber eine Verbesserung an der Polarisationseinrichtung von Mikroskopen.**

[The essential part of the arrangement consists in the facility for moving aside the polariser, which is fitted in a sleeve on a hinged arm, the illuminating and condenser lenses being unaffected. The low-power condenser lens is independent of the polariser, and the latter is protected by a cover-glass.]

*Tschermak's Mineral. u. Petrog. Mitth.*, XXI. (1902) p. 454.

Leiss, C. — **Krystallpolymeter nach C. Klein.**

[The author gives a full description of the instrument.]

*Zeit. f. Instrumentenk.*, XXII. (1902) p. 201.

Wendt, G. von.—**Eine ausgezeichnete Beleuchtungsquelle für mikroskopische Zwecke.**

[Strongly recommends the use of the Nernst lamp for microscopy. The light is constant, and when used with strong magnifications (2000 or more) the whole of the field is extraordinarily bright. The author considers it superior to any artificial or even natural light-source.]

*Zeit. f. wiss. Mikr.*, XVIII. (May 1902) pp. 417–8.

### (4) Photomicrography.

**Stereoscopic Photography of Microscopic Objects.***—W. Scheffer, after explaining the optical principles underlying the subject, proceeds to their application. When the object to be photographed has been brought into the field of view, the ocular is then removed, and one notes the position of the light-source (i.e. the carbon filaments of the lamp described in a previous section, fig. 18 *supra*). As the direction of the lateral displacement marks the horizontal, it is best to arrange that this displacement should be parallel to the edge of a plane. This is most conveniently attained by setting the lamp, with its stand, in such a position that the direction of the arm should be perpendicular to the longer edge of the plane, and this can be judged very accurately by the eye. By means of the screw a lateral movement in one direction is now given to the lamp until the carbon filament lies close to the periphery of the field ; then it is similarly moved to the opposite side. When the observer has convinced himself of the accuracy of these positions, the ocular is re-inserted, the object laid on the stage, and the first photographic plate taken. The carbon filament is then moved to the opposite position and the second plate taken. Stereograms so obtained were compared with the object, and were found to give an excellent physical presentation, exactly corresponding to reality. The camera used was

* Zeitschr. f. wiss. Mikr., xviii. (1902) pp. 408–12 (2 figs.).

that described in the next section, and it was found that a period of three minutes was quite sufficient to take a stereogram, including the necessary adjustment of light, slides, &c. If the stereogram is required to produce the impression of vision from above, the horizontal must be so arranged that the true place of the lamp is the apparent position of the observer. A lamp should be chosen the length of whose filament is a third of the diameter of the aperture of the objective ; the filament should be inclined lengthwise, at an angle of 45° to the horizontal.

**Improvements in the Vertical Microphotographic Camera.***—W. Scheffer describes (fig. 26) an arrangement by which a Microscope can be used in the ordinary way, and yet almost instantaneously adapted for use with a vertical camera. The spacious foot-plate has two adjustable bars, which are secured by binding-screws, and serve for putting the Microscope into the exact position for accurate centring with the camera. A strong pillar is at the further end of the foot-plate. In the upper and perforated end of this pillar is a steel rod carrying the camera, and rotatory about its axis ; it is notched for the adjustment over the Microscope, and is firmly clamped in this position by a screw. This arrangement secures the accurate adjustment of camera and Microscope. The rod not only bears sleeves with suitable arms for the camera, but is graduated so that the position of the ground-glass screen may be accurately controlled. The flame is so arranged that the double dark slide, &c. are not pushed, but dropped in ; in this way all trouble from jamming is avoided. The dark slide is of tin, and is pressed down by springs.

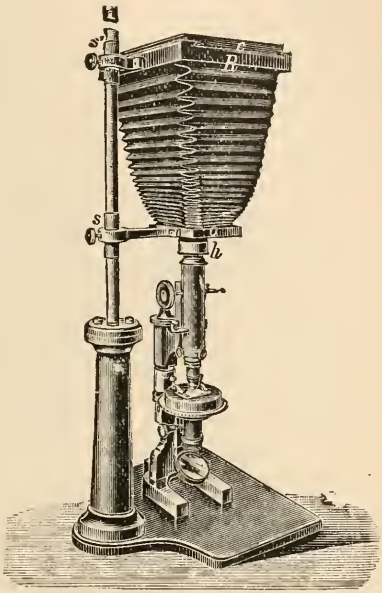


Fig. 26.

**Bagshaw's 'Elementary Photomicrography.'** †—This little book seems to correspond admirably with its title, and is written, as the author says in the preface, for the purpose of encouraging amateurs to commence the subject. It therefore aims at a clear exposition of principles and arrangements ; and endeavours to show how many results can be obtained with simple apparatus that almost any one might be supposed to possess. There are ten chapters and an appendix, photomicrography with low powers being, naturally, more fully discussed than high power work, where, however, some very useful hints are given.

Richards, M. A.—**Photomicroscopy of Metals as practised by Steel Companies.** [A useful practical paper.]

*Journ. App. Micr.*, V. (1902) pp 1920–6 (8 figs.).

* Zeitschr. f. wiss. Mikr., xviii. (1902) pp. 401–4 (1 fig.).

† Iliffe & Sons, London, 1902, 68 pp.

### (5) Microscopical Optics and Manipulation.

**Common Basis of the Theories of Microscopic Vision, treated without the Aid of Mathematical Formulæ.***—J. Rheinberg explains in four chapters the principles underlying the formation of a microscopic image. These chapters were intended to form the commencement of a little book dealing fully with each of the various theories of microscopic vision, which have been, at any time, propounded, and the author considers that their publication at the present time may be opportune, in consideration of the interest recently aroused in the subject by Mr. J. W. Gordon's paper.† The great feature in Mr. Rheinberg's paper is a method of showing and explaining the action of a diffraction grating by successive stages, beginning with two slots only. There are numerous clearly drawn diagrams. The chapters are headed: (1) Elementary Considerations; (2) The Image of a Lens; (3) Diffraction and Diffraction Gratings; (4) On Obliquity of Incidence and Cones of Light.

**Steinheil and Voit's 'Handbuch der Angewandten Optik.'‡**—This important handbook on applied optics is less known in England than it deserves to be. The first volume, which is the only portion as yet published, contains some 314 octavo pages, 7 lithographic plates as well as numerous illustrations. It is intended as an exposition of the methods of calculating optical systems, and for their application to simple and achromatic lenses. It consists of 5 chapters and 4 appendices. The contents of the chapters are: (1) Reflection and Refraction of Light, pp. 1–32; (2) Fundamental Peculiarities of a Dioptric System, pp. 33–54; (3) Conditions for an actual Lens-System and Enumeration of Mistakes to be avoided, pp. 55–66; (4) Computation of a Lens and Discussion of its Image Errors, pp. 67–143; (5) Achromatic Objectives of Two Lenses, pp. 144–206. The four appendices, which are partly due to Dr. Seidel, deal with the mathematics of geometrical optics, and include various tables of reference.

HAUSWALDT, H.—**Interferenzerscheinungen an doppeltbrechenden Krystallplatten im convergenten polarisirten Licht photographisch aufgenommen. Mit einem Vorwort von Th. Liebisch.** Magdeburg, 1902.

STREHL, K.—**Strenge Theorie der Lupe.**

[The author gives some notes and explanations on M. G. Quesneville's *Nouvelle Théorie de la Loupe* (Paris, A. Hermann, 1902). They concern the magnifying power of loups, Microscopes, and telescopes.]

*Zeit. f. wiss. Mikr.*, XIX. (1902) pp. 32–4 (1 fig.).

THOMPSON, S. P.—**Some Experiments on the Zonal Aberration of Lenses.**

*Arch. Néerland.* [2] VI. (1901) p. 747.

### (6) Miscellaneous.

**Cantor Lectures, 1902: Glass for Optical Purposes.§**—The lecturer, Dr. Glazebrook, devoted the first of the series of four lectures to an explanation of the defects of a lens (spherical aberration, astigmatism, coma, distortion, chromatic aberration), and of the chemical composition of optical glass. The second lecture showed how the defects were rectified in a modern microscopic objective. The third lecture dealt similarly with a photographic lens; and the fourth with telescopic objectives and combinations of telescopic and photographic lenses. The

* Zeitschr. f. wiss. Mikr., xix. (1902) pp. 1–32 (35 figs.).
† This Journal, 1901, pp. 353, 475. ‡ Leipzig, B. G. Teubner, 1891.
§ Journ. Soc. of Arts, Nos. 2601–7, Oct. and Nov. 1902 (59 figs.).

fourth lecture also explained the methods of lens-testing adopted at Kew Observatory and the official certificate issued. The lecturer referred to the following authorities as useful sources of information: Winkelmann's *Handbuch der Physik;* Müller Pouillet's *Lehrbuch der Physik;* M. von Rohr's *Theorie des Photographischen Objectivs;* Hovestadt's *Jenaer Glas;* Silvanus Thompson's translation of *Lummer's Photographic Optics;* and Dallmeyer's *Telephotography.*

**Molisch's New Freezing Apparatus.***—This (fig. 27) is intended for exhibiting objects under the Microscope in laboratories. It is said

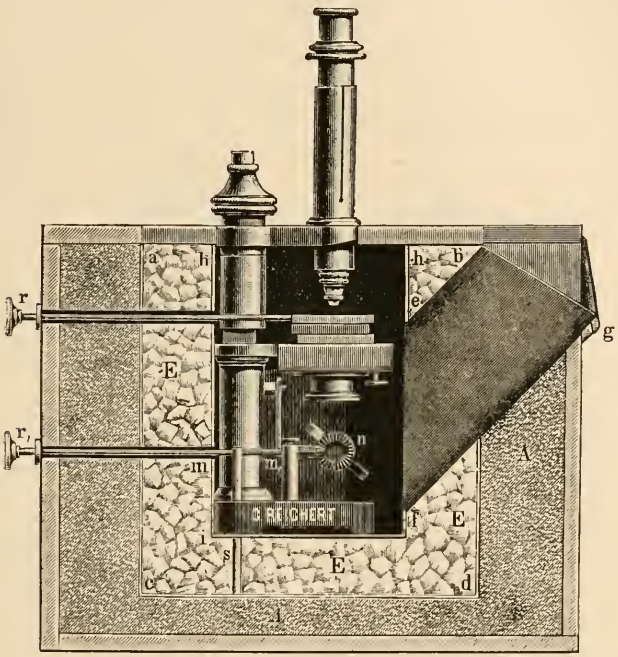



Fig. 27.

to be adapted for a constant temperature of − 10° C. A window admits light on to the mirror, and the various adjustments are effected by rods actuated from the exterior.

Dongier, R.—**Apparat zur Messung der Krümmung und anderer Constanten eines Optischen Systems.** *Zeit. f. Instrumentk.*, XXI. (1901) p. 362.

Kohn, R.—**Ueber mikroskopischen Electricitätnachweis.**
[The author reviews the limits of delicacy of the methods of electrical reactions observable by microscopic methods. He especially emphasises the electrolytic reactions when coloured or crystalline products are formed.] *Zeit. f. wiss. Mikr.*, XVIII. pp. 427–30.

Strehl, K.—**Plaudereien über Optische Abbildung—Mikroskopie; Spektroskopie.**
[Conclusion of a series of articles.]
*Central-Zeit. f. Opt. u. Mech.*, XXIII. (1902) pp. 193–4.

Wallérant, F.—**Sur un nouveau modèle de réfractomètre.**
*Bull. de la Soc. Franç. de Minéralog.*, XXV. (1902) p. 54.

* Zeitschr. angew. Mikr., viii. (1902) pp. 33–4 (1 fig.).

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Apparatus for Collecting Samples of Earth for Bacteriological Examination.†**—H. W. Wiley describes an apparatus for the collection of samples of earth for examination. It consists of tubes of brass, similar in construction to a cork-borer, one end bevelled, so as to easily enter the soil. Both ends are closed by rubber balls of slightly greater diameter, and the balls are held in position by small rubber caps. The apparatus is sterilised for one hour on two or three successive days. The method of collecting is quite simple. A ditch is dug, some three or four feet deep, and wide enough to hold the operator, and one side is made smooth. Samples are taken by means of separate tubes, usually beginning three inches below the surface, and continuing at stated intervals to the bottom of the ditch. A platinum spatula, sterilised in the flame of an alcohol lamp, is used to remove the surface of earth at the point where the sample is to be taken; both rubber caps are removed from the tube, and the cutting edge is forced into the soil with a turning movement, so as to fill the interior with a core of earth. The tube is withdrawn, the rubber caps are replaced, and the whole apparatus enclosed in a covering of sacking for transmission to the laboratory.

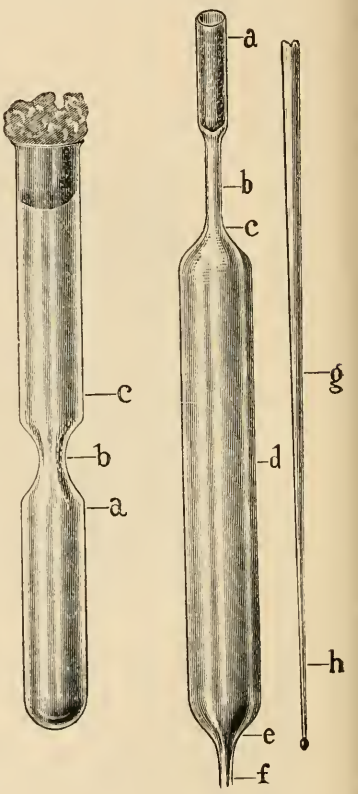



Fig. 28.




Fig. 29.

**Anaerobic Cultivation.‡**—D. Rivas claims that the following procedure for cultivating anaerobic organisms is new, simple, and effective. He uses a test-tube with a constriction in the middle (fig. 28). This is filled up to *a* with the medium, which is covered with a layer of oil reaching as high as *c*. The medium used is a mixture of bouillon, agar or gelatin, ammonium sulphide, and sulphindigotate of soda. To make 500 c.cm. of the medium in the least unpleasant way the following procedure is advised:—(1) Bouillon with 1 p.c. grape-sugar and 1·5 p.c. pepton, 474 c.cm. (2) Sulphindigotate of soda 10 p.c. solution in distilled water, heated for 1 hour at 100°, 1 c.cm. (3) Sodium sulphide 1 p.c. solution in distilled water, heated for 1 hour

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous. † Journ. Franklin Inst., cliv. (1902) pp. 81–91, 161–9 (1 pl.).

‡ Centralbl. Bakt., 1te Abt. Orig., xxxii. (1902) pp. 831–41 (4 figs.).

at 100°, 25 c.cm. The medium is then poured into the constricted tubes, covered with oil, and then the tubes are incubated for 48 hours.

In order to study isolated colonies, the author uses a flat tube with a long drawn out extremity (fig. 29), and holding about 8 c.cm. The agar or gelatin to be used is liquefied in test-tubes, inoculated, and diluted. The point of the long arm is then broken off at *h*, and then inserted into the tube containing the medium. By sucking at *a* the flat tube is filled as far as the neck. The neck and point are then melted off at *b* and *f*, and the closed plate placed in the incubator. As the tube is flat the colonies can be examined under the Microscope, and also easily photographed. By means of the media and this apparatus, the author has very successfully cultivated numerous anaerobic bacteria.

**Cultivating the Influenza Bacillus.***—E. Czaplewski makes a blood-agar culture medium with pigeon's blood. Some feathers are removed with scissors from the bird's breast, and the surface thoroughly cleansed with cotton-wool soaked with alcohol. A slight incision is then made with a lancet, and the blood withdrawn by means of a pipette. The blood is then squirted into a flask, on the bottom of which is a layer of liquid agar (about 10 c.cm.). The ingredients are then mixed by careful shaking. The flask should be kept in a water-bath to prevent the agar setting. More agar is poured in until the correct tone of colour is obtained. The mixture is then passed into test-tubes or Petri dishes, and slants or plates made. With the usual precautions, such as are now employed in bacteriological laboratories, contaminations of the blood-agar are quite rare.

MEYER, E.—**Einige neue Apparate zum Schöpfen von Wasser zu bacteriologischen Zwecken.** (New apparatus for obtaining water for bacteriological purposes.) *Centralbl. Bakt.*, 1te Abt. Orig., XXXII. (1902) pp. 845–8 (4 figs.).

### (3) Cutting, including Imbedding and Microtomes.

**Simple Method of Making Thin Paraffin Sections.**†—W. Kolmer and H. Wolff describe a new procedure for making paraffin sections without the employment of fixatives. The chief agent is carbonic acid. To the cylinder containing the liquid gas is attached a tube 20 cm. long. Over the tube is placed a bag made of two layers of velvet. The bag is about the size of a child's head, and is fastened to the tube with strings and a clamp. The tap is opened for a moment. The bag becomes filled with solid $CO_2$, which is transferred to a pan and stamped down with a pestle. After repeating the process several times, a cake of solid carbonic acid is obtained which will retain a temperature of about − 80° C. for 10–12 hours.

The cake is then put in an exsiccator, on the bottom of which is placed a small copper tube containing paraffin (melting-point 32°). On the layer of paraffin is placed the piece of fresh tissue (50 c.cm. in bulk). The piece freezes instantly. A dish of pentoxide of phosphorus is also placed in the exsiccator. The air is then removed by means of a water or mercury pump. In about 100 hours the piece of tissue is freed from its water. The exsiccator is then put in a thermostat to thaw the piece

* Centralbl. Bakt., 1te Abt. Orig., xxxii. (1902) pp. 667–70.
† Zeitschr. f. wiss. Mikr., xix. (1902) pp. 148–50.

of tissue, and in this way saturation of the piece with paraffin is accomplished *in vacuo*. The blocks are easily cut on a freezing microtome, yielding sections 5 $\mu$ thick.

The most important features of this method are that vital staining is retained in the sections, and Nissl's bodies are clearly evident.

**Preparing Serial Sections of Insects.***—J. B. Scriven, while following generally the technique of Lowne, has introduced several time-saving modifications. After the object has been fixed, it is dehydrated in hot absolute alcohol and then placed straight away in the following imbedding medium. Paraffin (45° C.) 80 grs. white wax 10 grs., anhydrous creosote 2 minims, solution of caoutchouc in pure benzol (1 gr. to 5 fl. dr.), 2 minims. This medium cuts well at the temperature of the laboratory (16° C. *circa*). The sections are stretched on and fixed to the slide with warm water. After allowing the ribands of sections to dry by evaporation, the imbedding medium is removed by a rapid flooding with benzoline, which in its turn is removed with absolute alcohol. The other steps do not differ materially from those usually adopted.

**Examining Oligochætæ.**†—For his experiments on the regeneration processes in limicolous Oligochætæ, M. Abel used *Tubifex rivulorum* and *Nais proboscidea*. The regenerative parts, as well as a number of normal segments, were immersed for 1 to 1½ hours in Hermann's fluid (platinum chloride-osmic-acetic acid). This solution was found to act better than hot sublimate. After the preparations had been washed and hardened they were imbedded in paraffin, and then transverse and longitudinal sections 5 $\mu$ thick were made. The sections were stained with hæmatoxylin or with Haidenhain's iron-hæmatoxylin solution.

#### (4) Staining and Injecting.

**Fixing Neutral Red.**‡—E. Golovine describes a method of fixing neutral red in the tissues after *intra vitam* staining. The animals used were Nematoda, Turbellaria, &c. The treatment of the object after *intra vitam* staining is divided into five sections: (1) precipitation of the neutral red; (2) fixation of the material; (3) washing and dehydration: (4) imbedding in paraffin; (5) after-staining of the sections. Neutral red may be precipitated and the object fixed at the same time by means of saturated solution of sublimate either alone or in combination with other fixatives such as picric acid, acetic acid, osmic acid, and platino-osmic-acetic acid mixture. Other fixatives mentioned are chromic acid and its salts, iodide of potassium, picric acid, bichloride of platinum, and chloride of gold. Washing is effected by means of saturated aqueous solutions of vanadic, picric, or molybdenic acids, in picrate of ammonia, and under certain circumstances in molybdate of ammonia. For dehydrating, mixtures in various proportions (seven formulæ are given) of water, saturated solution of molybdate of ammonia and 90° alcohol are used. The material is cleared up with toluol, xylol, and oil of cloves, after which it is imbedded in paraffin. The sections must be stuck on with

* Journ. Quekett Micr. Club, viii. (1902) pp. 343–8.
† Zeitschr. f. wiss. Zool., lxxiii. (1902) pp. 3–4 (3 pls.).
‡ Zeitschr. f. wiss. Mikr., xix. (1902) pp. 176–85.

celloidin as albumen dissolves neutralised. For histological staining of the sections, the following solution is used : water 100 c.cm., hæmatoxylin 1 grm., chloral hydrate 7–9 grm., 50 p.c. acid molybdate of ammonia 20–30 drops. The mixture is exposed to the light for 8–10 days. The sections stain in a few seconds.

**Staining Axis-Cylinders with Carmin.*** — E. Chilesotti describes the following method for staining axis-cylinders. (1) Fixation, Müller's fluid for 4 months or more, or formol-Müller (1–10), or formol (about 1 p.c.) for 4 days at least. (2) Impregnation (only for pieces fixed in formol or in formol-Müller) in Weigert's solution for staining medullary sheaths. (3) Imbedding in celloidin. (4) Sectioning. (5) Staining. The staining solution is made by boiling for half-an-hour 1 grm. of carmin nacarat (Merck) finely powdered, in about 250 c.cm. of tap-water. After standing for 24 hours, the clear fluid is decanted off and then is added one drop of an alcoholic solution (70°) of hydrochloric acid (1 p.c.) to each c.cm. of aqueous carmin (3 c.cm. to 100 c.cm.). The mixture is then briskly shaken twice at intervals of 5 minutes. After standing for 24 hours the clear fluid is decanted off. Thymol 1–1000 is added to prevent mould. The sections remain at least 20 hours in the staining solution, and on removal are washed in distilled water. (6) Differentiation. The sections are immersed for 30 seconds in an aqueous solution of permanganate of potash 1–2500 (i.e. 5 parts of water and 1 part of $\frac{1}{4}$ p.c. of Pal's solution). They are then transferred for 10–60 seconds to a saturated aqueous solution of sulphurous acid ($SO_2$ 5 p.c.). Wash in water and repeat the procedure, diminishing the stay in permanganate, until the section is of a rose colour traversed by reddish lines. Finally, 96 p.c. alcohol, carbol-xylol, Canada balsam.

The axis-cylinders and the ganglion-cells are stained red while the neuroglia and the medullary sheaths are quite decolorised. The red corpuscles, the nuclei of the neuroglia, are partially stained.

The author calls the attention of microscopists to this selective staining by means of carmin, a pigment which has been much neglected in recent times.

**Staining and Preservation of Series of Sections on Paper Slips.†** A. Schoenemann, after mentioning the material worked with (nasal cavity of infants, petrous bone of adults), describes the method of decalcifying. At first 7 p.c. sulphuric acid was used, but afterwards sulphurous acid. The material was immersed in a saturated solution, and as long as it remained therein, remained hard, but on being transferred to water the bone salts dissolved out. After dehydration in absolute alcohol, the objects were transferred to a mixture of ether and oil of cloves (2–1), and then to Stepañow's celloidin, which consists of celloidin chips 1·5 grm., oil of cloves 5 grm., ether 20 grm., absolute alcohol 1 grm.

After a time, varying according to the size of the object, they were covered with chloroform, and when sufficiently hard the paper casing was stripped off and the mass placed in chloroform. When the hardening is complete the blocks are transferred to cedar-wood oil if they are to

* Zeitschr. f. wiss. Mikr., xix. (1902) pp. 161–76. † Tom. cit., pp. 150–61.

be dry cut. If wet cutting be preferred, the chloroform bath is not used but the blocks are hardened in 80 p.c. alcohol. The author prefers the dry cutting method, and sticks the block on with a thick solution of collodion or with paraffin. As the sections are cut they are placed on strips of specially prepared colour-proof paper, one end of the strip being reserved for notes on identification, &c. When a sufficient number of sections have been placed in position they are flattened down with blotting-paper. The paper strips are then immersed in 80 p.c. alcohol, in which they are freed from the cedar-wood oil. When the sections are to be stained, the strips are placed in a water-bath to extract the alcohol, after which they are treated with hæmatoxylin, such as hæmalum, Grenacher's, Delafield's, in dilute solutions. The strips are placed in tap-water to bring out the colour well and then in 95 p.c. alcohol to which eosin has been added. In this way they are contrast-stained and partially dehydrated. The next step is to treat the sections with carbolxylol (1–3) and then with xylol. What the next procedure is depends on whether it be decided to preserve the strips or examine them in the dry or moist condition. If the latter, the strips are soaked in cedar-wood oil, and then placed on a slide and covered with a strip of glass or mica.

If they are to be preserved in the dry state, they are coated with elastinlack (Grübler). This varnish dries in from 12 to 24 hours. The strips must be kept in a cool place.

**Staining the Plague Bacillus.***—E. Horniker obtains excellent polar staining of *B. pestis* by treating the air-dried and flame-fixed films with saturated alcoholic solutions of methylen-blue and gentian-violet. After allowing the stain to act for 1½ to 2 minutes, the preparation is washed with water.

**Staining Malaria Parasites with A-Methylen-Blue-Eosin.**† — K. Reuter practises the following procedure. The air-dried film is fixed in formol-alcohol (formol 10, absolute alcohol 90), and then carefully dried with blotting-paper. The preparations are then immersed in the stain (aq. destill. 20 c.cm., A-methylen-blue-eosin (Grübler) 30 drops). By tilting the capsule containing the staining solution after the manner of developing a photographic plate the staining process is materially accelerated ; it should be completed in 15–20 minutes. The film is then washed with distilled water, and after having been mopped up and dried in the air, is mounted in balsam.

**Staining the Parasites of Malaria perniciosa.**‡ — G. Maurer recommends the following procedure for staining the parasites of pernicious malaria. The chief requisites are a good film, careful drying and hardening, and a very ripe alkaline methylen-blue solution. The slides must be perfectly clean, and the film made after the method of Jancso and Rosenberger. The film is first dried in the air, and then fixed by immersing it for 10 to 15 minutes in alcohol-ether. On removal it is dried in the air or in the flame. It is then ready for

* Centralbl. Bakt., 1te Abt. Orig., xxxii. (1902) pp. 926-8.
† Tom. cit., pp. 842–5. ‡ Tom. cit., pp. 695–717 (3 pls.).

staining. In a 60 c.cm. flask 10 drops of methylen-blue solution are mixed with 25 c.cm. of tap-water, and in another flask 15 drops of eosin solution with 25 c.cm. of tap-water. The latter is then poured into the former, after which the blood preparation is immersed in the mixture and kept moving about briskly for about five minutes. On removing the preparation water is poured over it to get rid of the superfluous stain. The preparation is now probably too blue, and the excess is removed by immersing in distilled water. If this be not sufficient, the preparation must be dried and again treated with distilled water.

The ordinary methylen-blue solution may be used (1 p.c. aqueous methylen-blue med. Höchst with ½ p.c. soda), but 1–2 p.c. ammonia or $\frac{1}{10}$ p.c. caustic potash are better than the soda. This solution takes 4 to 6 weeks to ripen. The eosin solution is a 1 p.c. solution in distilled water. Though the proportion of 10 methylen-blue to 15 eosin was found to be best for most cases, yet when the methylen-blue is weak or unripe, it may be increased to 15–25, and conversely, when too ripe and strong may be reduced to 7–15.

**Demonstration of Flagella in Coccaceæ.*** — D. Ellis has demonstrated the presence of flagella in a large number of Coccaceæ by the following method. The samples, which were obtained from Král's laboratory, were sown first on dextrose-agar and Spirillum-agar. As soon as any growth was perceived, a trace thereof was inoculated on fresh agar, and this procedure was repeated until movements in individual cocci became evident, after which they were re-inoculated and cultivated until a culture was found suitable for flagella preparations. In general A. Meyer's method of fixing and staining (see this *Journal*, 1900, p. 373) was adopted, though modifications in the fixation, length of mordanting, and staining were had recourse to. As a rule, the preparations were fixed for 5 minutes at 40° C., and then mordanted for 4–6 minutes at room temperature. For staining, acid-violet was used ; this was heated until it vaporised, after which the preparation was allowed to stand for 2 minutes at room temperature.

As the result of the foregoing procedure, the author infers that all species of *Coccaceæ* are flagellated.

**Stain for Elastic Fibres.**†—J. H. Stebbins, jun., recommends the following method by which elastic fibres are stained dark-blue to blue-black. Dissolve 2 grm. fuchsin and 4 grm. resorcin in 200 c.cm. of boiling water. While boiling add 25 c.cm. of liquor ferri sesquichlorid. and boil for 5 minutes longer ; then cool and filter. Dissolve the precipitate collected on the filter in 200 c.cm. of 94 p.c. alcohol by boiling, and when all is dissolved bring the volume of the fluid up to 200 c.cm. with 94 p.c. alcohol. Finally add 4 c.cm. of HCl, mix well by shaking, and the stain will be ready for use.

The material may be fixed in Zenker's fluid, or in formaldehyde. The sections are stained for 20 to 60 minutes, washed in absolute alcohol, cleared in xylol, and then mounted. If desired, they may be previously contrast-stained with carmin.

* Centralbl. Bakt., 2te Abt., ix. (1902) pp. 546–60 (2 pls.).
† Journ. N.Y. Micr. Soc., xvi. (1901) pp. 4–5.

### (5) Mounting, including Slides, Preservative Fluids, &c.

**Making Preparations of Crystals for the Micropolariscope.***—S. E. Dowdy says that the first essential of success is to get the slides perfectly free from grease. Rubbing them with a paste made by working up a little prepared chalk with equal parts of rectified spirit and liquid ammonia, drying, and finally polishing on chamois leather, answers well. Make a saturated solution of the chemical in cold distilled water in a test-tube. Warm the supernatant fluid so that it may take up a little more of the salt in solution. Deposit a drop or two of the warm solution in the centre of a slide and allow it to spread. If it do not form a film but remain as a globule it is a sign that the slide is still greasy. If a film forms, it should be covered with a watch-glass and the slide put aside to cool. The results are better from slow cooling, but the process may be hastened by heating the liquid on the slide until a thin film of salt appears at the edge and then putting aside to cool. When formed, the crystals should be mounted at once in xylol-balsam of thick viscid consistence.

### (6) Miscellaneous.

**Interesting Extract from Hooke.**†—"Nature is not to be limited by our narrow apprehensions; future improvements of glasses may yet further enlighten our understanding and ocular inspection may demonstrate that which as yet we may think too extravagant either to suppose or feign."

This quotation occurs in connection with a letter received from "the ingenious and inquisitive Mr. Leeuwenhoeck, of Delft," sent October 5, 1677. In this letter, Leeuwenhoeck speaks of the vast number of animalcules to be seen in an infusion of pepper, and Hooke calculates that over 8,000,000 of these minute animals exist in a single drop.

The work from which the extract is taken is entitled 'Lectures and Collections made by Robert Hooke, Secretary of the Royal Society,' 1678, p. 118. The latter part of this collection has a second title, 'Microscopium or some new Discoveries made with and concerning Microscopes.'

**Handbook of Instructions for Collectors.**‡—The authorities of the British Museum (Natural History) have issued in book form the series of pamphlets, treating of the collecting and preservation of specimens, which were chiefly drawn up for the better information of voluntary collectors resident abroad. The various chapters have been written by different members of the staff of the Natural History Museum. Much valuable information is contained in the booklet, though a few more diagrams would have been useful adjuncts to the verbal descriptions. On the other hand, illustrations such as that of a cyanide bottle seem somewhat superfluous, and the morality of the advice (p. 129) to bribe customs officers is more than doubtful.

**Physiological Histology.**§—G. Mann's *Methods and Theory of Physiological Histology* is bound to command widespread interest among

* Engl. Mech., lxxvi. (1902) pp. 319-20. † Brit. Mus. Cat., 233 h. 5.
‡ Printed by order of the Trustees of the British Museum, London, 1902, 137 pp., with illustrations. § Oxford, Clarendon Press, 1902, vii. and 488 pp.

physiologists and pathologists, as it is the first work in the English tongue which has treated the practice and theory of fixation and staining in a thorough and scientific manner. Its contents will well repay a careful examination, and the volume will, no doubt, soon be found in every well appointed laboratory. The first nine chapters deal with the various aspects of fixation. These are followed by others describing the methods of bleaching, decalcifying, injecting, and of obtaining sections. In chapters fourteen to twenty, dyes and staining are treated of. To these succeed impregnation methods, the chemistry of some tissue-constituents, and microchemical reactions. In chapter xxiv. the theory of staining is discussed at considerable length and with much erudition and knowledge.

In the last chapter are described the methods for rendering preparations permanent. The book concludes with an appendix in which the chemistry of dyes is dealt with in much detail, and with a note on micro-anatomical reaction.

In conclusion, we may say that the author has succeeded in producing a work of considerable merit, which is marked throughout by accurate knowledge of the theory of the subject and by practical experience of the methods discussed. It is the work of one in authority, and quite unlike many compilations which profess so much.

'**Modern Microscopy.**'*—This useful handbook, which this year has reached its third edition, is the outcome of the knowledge and experience of M. I. Cross and M. J. Cole, by whom the text has been entirely revised and considerably enlarged. The information regarding the Microscope and microscopical technique has been brought up to date and much extended in scope. A new feature of the present edition is a chapter on the choice and use of microtomes. The general get-up of the volume, which is freely illustrated, is very good.

**Microscopic Examination of Paper Fibres.**†—W. R. Whitney and A. G. Woodman, in a very useful communication, give an account of the procedure they adopt for examining paper fibres microscopically. As a rule, a magnification of 60 diameters only is required, but higher powers are at times useful. The Microscope must be fitted with apparatus for viewing objects with polarised light. The paper to be examined is torn into small bits, and these are boiled for a few minutes in a 1 p.c. solution of caustic soda; then the pulpy mass is poured on a fine sieve (about 100 meshes to the linear inch) and washed with water until practically free from alkali. The pulp is transferred to a bottle half filled with water, and shaken vigorously to break up any lumps. It is not advisable to use glass beads or garnets to assist in the dissociation, but it may be necessary, in order to separate the fibres, to fray them gently in a mortar. The fibres may be inspected in water or glycerin and water, and permanent mounts made in agar, glycerin-jelly, or Canada balsam. Several should always be prepared, in order to be sure that examples of the various cell-forms may be obtained. The slides are to be examined by direct, and by polarised light, and their

* Baillière, Tindal & Cox, London, 1903, xvi. and 292 pp. and 77 figs.
† Technology Quart., xv. (1902) pp. 272-307 (94 figs.).

various characteristics noted down. In this way their identity may be narrowed down to three or four fibres, and their exact identification established by reference to detailed descriptions given by the authors in their valuable paper.

**Method of Making Collodion Tubes.***—K. Kellerman pours 3 p.c. collodion into test-tubes of suitable size. The tubes are then rapidly revolved, so as to coat the interior The superfluous collodion solution is poured off, and the tube is then placed in the inverted position to allow it to drain easily, and to dry and harden the film. The tube is allowed to stand for three minutes to one hour, and then filled with water. This loosens the collodion, so that the tube is easily drawn out.

**Ink for Writing on Glass.**†—P. G. Unna uses an ink for provisionally marking slides composed of zinc oxide 7·5, gelanth 7·5, distilled water 15.

**New Micrometer.**‡—This instrument (fig. 30), devised by Sir J. Hooker, obviates the inconvenience of the double measurement involved

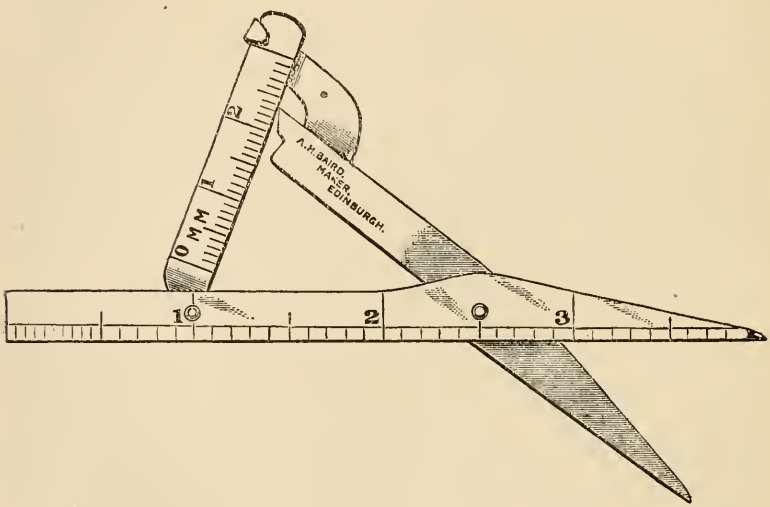



Fig. 30.

in the use of compasses and a rule. It records the length of an object up to a fraction of an inch or millimetre, one side of the scale being graduated to inches and the other to millimetres. It is specially useful for work with the dissecting Microscope, as the object may be measured without removing the eye from the ocular. The instrument is 4 in. in length, and as it is graduated for the ordinary and metric systems, it furnishes a ready means of converting the reading of one scale into terms of the other. It is made by A. H. Baird of Edinburgh.

* Journ. App. Micr., v. (1902) p. 2038.
† Monatsch. Prakt. Dermatol., xxxii. (1901) p. 343.
‡ A. H. Baird, Edinburgh: Catalogue, 1902 (1 fig.).

**New Colony-Counter.***—L. S. Ross describes a new bacteria colony-counter (figs. 31–33), of which a great feature is that the glass bearing the ruled lines can be brought quite close to the growth, by which a great source of error is eliminated. A glass disk ruled to square centimetres is mounted on the end of a short barrel that moves freely by

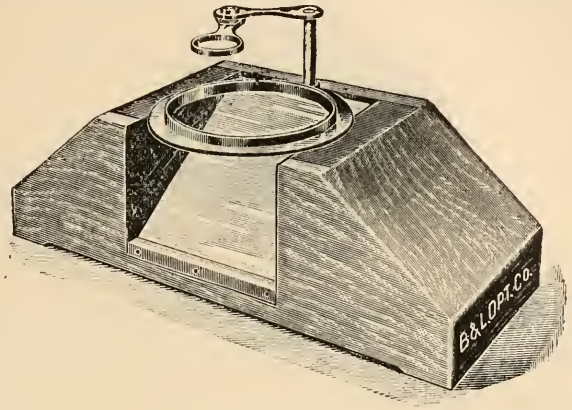



Fig. 31.

screw-thread within a collar. A block similar to that used in the Barnes dissecting Microscope has a metal circle on the top over the mirror, of a size to hold the 100 mm. Petri dish ; a rim is on the circle to hold the dish in position. Underneath the circle a mirror, or a black surface if

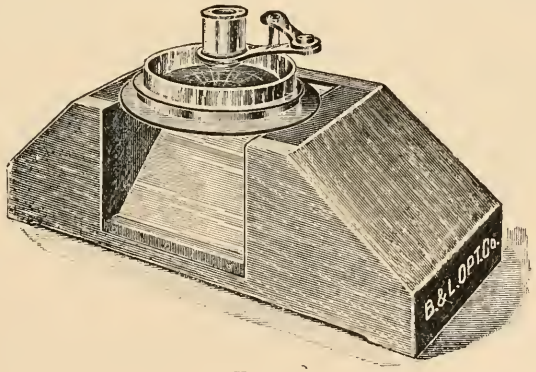



Fig. 32.

desired, is placed at an angle of 45 degrees. A sliding-post bearing a jointed arm is set into the block, to hold the lens in counting. The dish to be counted is set upon the circle, the cover is removed, and the barrel is placed disk down inside the dish, the collar holding the barrel resting upon the edge of the dish. The barrel is lowered through the

* Journ App. Micr., v. (1902) pp. 1970–1 (3 figs.)

collar by means of the screw-thread until the ruled glass is close to the gelatin. The barrel is of such a length that the ruled glass may be brought close to the gelatin in dishes of various depths. By means of the jointed arm the lens is swung into place and may be carried over the entire surface of the dish. The apparatus is made by Bausch and Lomb.

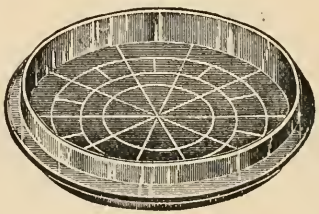


Fig. 33.

Abba, F.—**Manuale tecnico di microscopia e batteriologia applicate all' igiene.**
Torino (Claussen) 1902, 8vo, 671 pp., about 351 figs.

Cajal, S. Ramon y.—**Elementos de histologia normal y de técnica micrográfica.**
3rd ed., Madrid, 1901, 8vo.

Ehrlich, P., Krause, R., Mosse, M., Rosin, H., und Weigert, C.—**Encyklopädie der mikroskopischen Technik mit besonderer Berücksichtigung der Färbelehre.** Abt. 1, 2.
Wien (Urban u. Schwarzenberg), 1903, 8vo, 800 pp. and numerous figs.

Gorham, F. P.—**A Laboratory Course in Bacteriology.**
London (Saunders), 1901, 8vo.

Strasburger, E.—**Das botanische Prakticum. Anleitung zum Selbstudium der mikroskopischen Botanik für Anfänger und Geübtere, zugleich Handbuch der mikroskopischen Technik.**
4th ed., Jena (Fischer), 1902, 8vo, 771 pp. and 230 figs.

Wright, A. E.—**New Procedures for the Examination of the Blood and of Bacterial Cultures.**
[(1) On the possibility of dispensing with the standard pipettes and micrometrical rulings of the hæmocytometer. (2) On a method of determining under the Microscope the number of micro-organisms contained in bacterial cultures. (3) On a simple procedure for coagulation tubes of standard calibre; also a note on the practical importance of the information obtained from the coagulometer.]
*Lancet*, 1902, II. pp. 11–7.

## Metallography.

**Metallography: an Introduction to the Study of the Structure of Metals chiefly by the Aid of the Microscope.***—This is the title of a useful work by A. H. Hiorns. The author believes it to be the first on the subject in the English language, and as the principles of metallography are yet in their infancy, he has not attempted any strictly logical basis of treatment. The book is divided into thirteen chapters, the first three of which are devoted to methods of preparation; the others treat of the various metals and their alloys. The book is also subdivided into sections, and the numerous photomicrographs amply

* Macmillan & Co., 1902, 158 pp. and 96 photomicros.

illustrate our present knowledge of the subject. A glossary of technical terms is appended.

**Fracture of Metals under repeated Alternations of Stress.***—J. A. Ewing and J. C. W. Humphrey have investigated by means of the Microscope the process by which iron becomes "fatigued" and breaks down, when subjected to repeated reversals of stress. It is shown that, although the greatest stress may be much within the limits of elasticity, it produces rupture after many reversals. The first visible effect is the production of slip-bands here and there on individual crystals. These gradually become more numerous. They also become accentuated and broadened, and their edges turn rough and burred, apparently as a result of grinding of one surface on the other over the plane in which the slip has occurred. At a later stage certain of the slip-bands develop into cracks, the cracks spread from crystal to crystal, and fracture ensues.

**Volatilisation and Recrystallisation of the Platinum Metals.†**—For the measurement of high temperatures by means of thermo-elements, it is usual to employ a combination of a platinum wire with one of platin-rhodium (Le Chatelier), or with one of platin-iridium (Barus). L. Holborn and F. Henning have undertaken experiments to test the suitability of these materials, and especially to discover whether the crystalline structure suffered any degeneration in consequence of prolonged heating. It was found that alloys of platinum and iridium at a temperature of 1500° C. lose weight considerably, and metallographic examination showed extensive disintegration of structure. The other metals and alloys were practically unchanged.

CAMPBELL, W.—**Upon the Structure of Metals and Binary Alloys.**
[Discusses methods, crystalline structure, effects of strain, effects of heat treatment, and representatives of the various groups of binary alloys.]
*Metallographist*, V. (1902) pp. 286–334 (38 figs.).

HOUGHTON, S. A.—**The Internal Structure of Iron and Steel with special reference to defective Material.**
[A very clearly written paper, copiously illustrated with excellent photo-micros.] *Metallographist*, V. (1902) pp. 257–85 (34 figs.).

* Proc. Roy. Soc., lxxi. (1902) p. 79.

† S.B. d. k. Preuss. Akad. d. Wiss. zu Berlin, xxxix. (1902) pp. 735–43 (11 photo-micros).

## MICROSCOPY.

### A. Instruments, Accessories, &c.*

#### (1) Stands.

**New Arrangement for avoiding Injury to Preparations when Focussing with High Powers.†**—A. Bourguet's contrivance for this

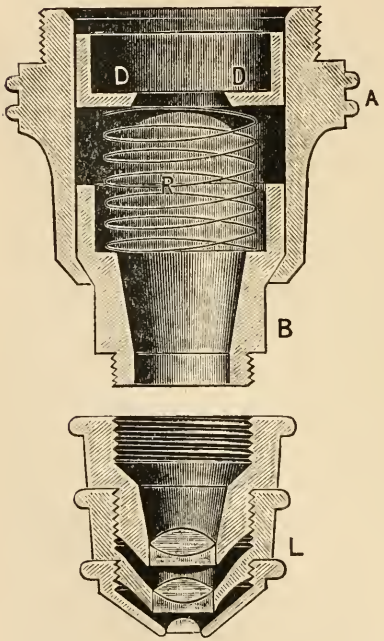



Fig. 37.

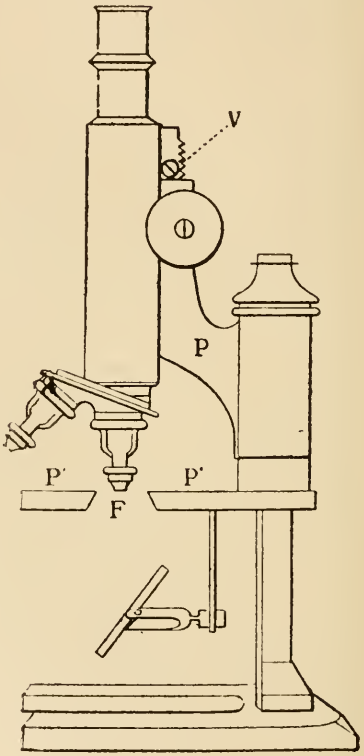



Fig. 38.

purpose consists of a special tube-funnel and a stop for limiting the descent of the Microscope-tube. The funnel (*entonnoir*) is that upper part of the objective-mount which does not contain a lens, and is here

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Zeitschr. f. wiss. Mikr., xix. (1902) pp. 35–40 (2 figs.).

made of a special shape, being composed of two separate pieces, A and B (fig. 37), one within the other, instead of one single piece. The upper piece A bears above, as usual, the universal screw-thread for securing the objective to the revolver or Microscope-tube ; below it tapers, conewise, for receiving or retaining in its lower part the other piece B. The latter is formed of two cylindrical parts of unequal diameter fitting exactly into the conical part of A ; it bears on its lower part a screw-thread, on to which the objective system L is to be screwed. A very weak spiral spring R operates between the lower face of the diaphragm D and the upper part of the shoulder of B. The pressure of the spring keeps B and A in close contact by their conical shoulders. B projects 5 mm. (exclusive of the threaded part) below A. In order to facilitate the screwing-on of L and prevent useless rotation of B, a vertical groove is cut in either A or B, in which a pin secured to the other engages. If, in the action of focussing, the tube is lowered too far the preparation will bear only the weight of the objective and will, by the operation of the spring, be relieved from further pressure. The stop system, which is shown in fig. 38, secures that the tube shall not be lowered beyond a certain safe limit, which should be selected with regard to the highest power of the operator's series. This stop is merely a screw V applied to the side of the rackwork, and its head comes into contact with the upper part of the limb when the tube is at the assigned depth. To exactly determine the position of V the micrometer-screw is fully racked down. Then the strongest objective, previously provided with a sliding funnel of 5 mm. range, is screwed on and the tube is then racked up until the lower extremity F of the objective is exactly on a level with the upper surface of the stage P′ P′. The point where the rackwork emerges from the limb is V.

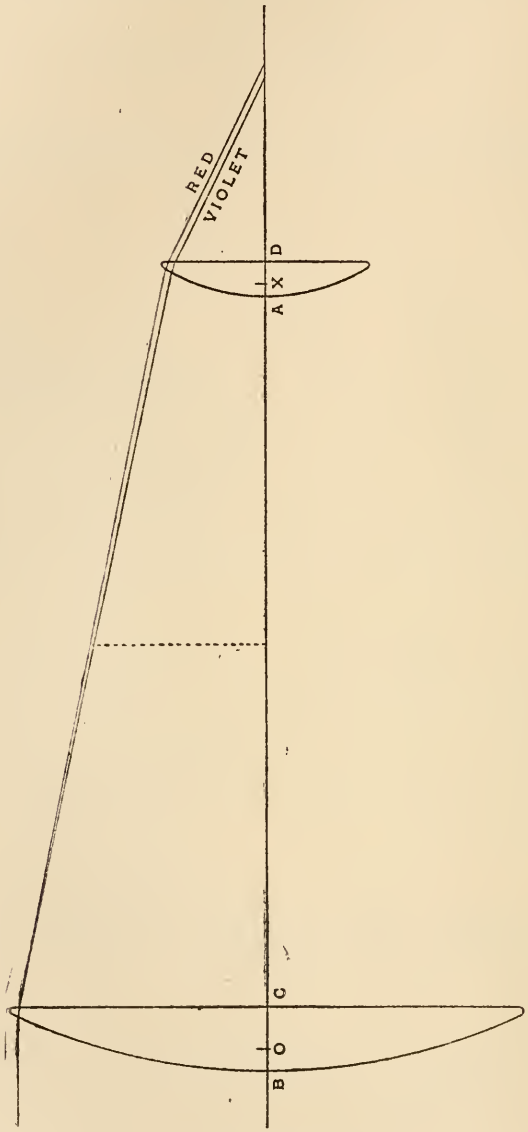
**Modern Fine Adjustments.*** — W. Forgan lays down the various qualities essential to a good fine adjustment and discusses some thirty-four different types. Some of these types are of historical interest only ; others exemplify the different constructions adopted by the best-known modern makers of all countries. He concludes by summarising the types before the public as three :—(1) The Powell and Lealand ; (2) the Zeiss ; and (3) the Watson Edinburgh Student's Microscope.

#### (2) Eye-pieces and Objectives.

**Eye-piece Lens Interval as arranged for Achromatism.†** — J. Hunter illustrates his remarks on this subject by reference to fig. 39, which is the double-lens achromatic eye-piece of a telescope. The lenses are plano-convex. The points A B are the optic centres ; C D the planes of the flat sides ; O X the posterior focal centre (cardinal points) of the field and eye-lens respectively ; the anterior focal centres coincide, in this kind of combination, with the optic centres. The author points out that various writers of high mathematical repute have variously estimated the separation interval as D C, A C, or A B ; X O does not appear to have been selected by any writer. He himself prefers A O.

* Proc. Scottish Micr. Soc., iii. (1902) pp. 137–57.
† Tom. cit., pp. 294–9 (1 fig.).

He found that when a pair of lenses of the same glass were placed experimentally at such a distance apart as to give the best achromatic




Twice original scale.

Fig. 39.

image, that the value of A O, so obtained, agreed with the value of $d$ calculated from Airy's more complete formula for achromatism, viz. :—

$$d = (f_1 + f_2)\left(2 - \frac{f_1}{u}\right)^{-1};$$

where $d$ = distance between the lenses ; $f_1 f_2$, the focal distances of field and eye-lenses respectively ; $u$, the distance between the field-lens and the centre of the objective.

**(4) Photomicrography.**

**New Device for Stereoscopic Photomicrography.***—F. E. Ives has recently made a one-plate-one-exposure stereoscopic photomicrographic

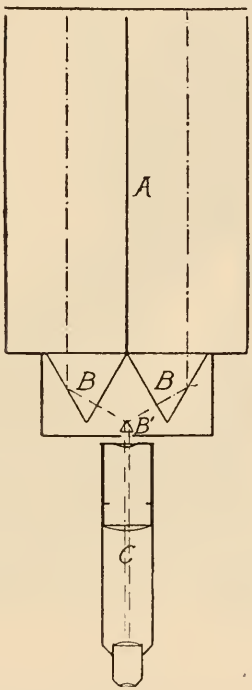



Fig. 40.

camera which is interchangeable with his single camera on the adjustable base.† It consists of a light telescopic box camera for plates 3¼ by 6 in., provided at the front with a small prism-box containing three equilateral prisms so disposed as to divide the light at the eye-point above the eye-piece of the Microscope, and project the divided rays upwards to form the two stereoscopic images. Fig. 40 shows the parts drawn to scale.

* Journ. Franklin Institute, cliv. (1902) pp. 391–3 (2 figs.).

† Op. cit., cliii. (1902) p. 375; and this Journal, 1902, p. 491.

A is the camera, B B B′ are the prisms, C is the Microscope-tube with objective and low-power eye-piece, D is the object-slide, and the dotted lines show the path of the axial rays from the back of the objective. The author considers that it is much better to divide the light, in this manner, at the eye-point than to divide it, as is generally done, at the back of the objective. If a lens of the focal length of the camera be added as a cap for the eye-piece, the camera can be used without even refocussing, in the fashion of the author's previous instrument. The prism-box has a lateral fine adjustment by screw on the camera front,

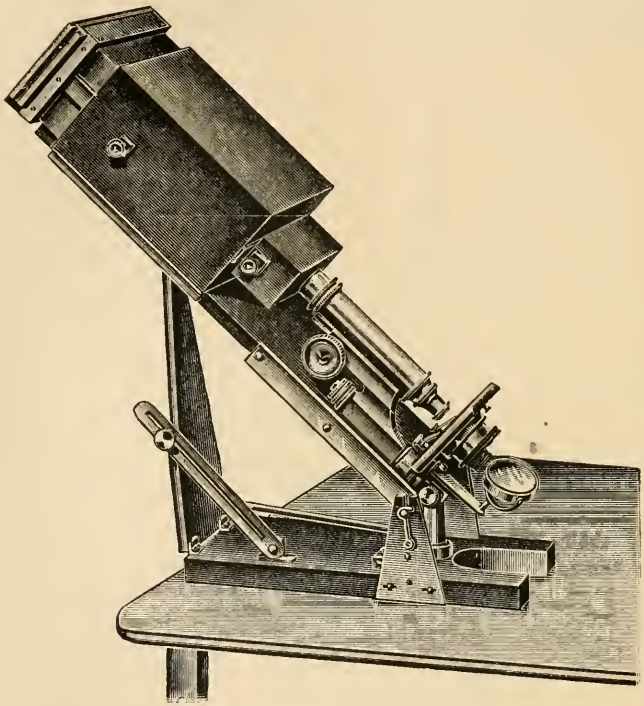


Fig. 41.

in order to readily set it, so that the apex of the small prism should exactly bisect the circle of light at the eye-piece. The negatives produced in this camera are ready for printing from, no transposition of images being necessary. Fig. 41 shows the stereoscopic camera used on the adjustable base, as recently improved. The combination can be adapted to the Microscope at any inclination and brought into action in a few seconds ; and, after exposing, it is removed as a rigid whole by a single rectilinear movement of one hand.

**New Upright Photomicrographic Apparatus.*** — In designing his apparatus J. A. Terras has studied the convenience of the operator. As

* Proc. Scottish Micr. Soc., iii. (1902) pp. 210–2.

will be seen from fig. 42, the arrangement practically comprises a Van Heurck camera, in which the solid body has been replaced by a conical bellows, and the limbs elongated sufficiently to make the instrument completely independent of other supports; while the Microscope-table has become an integral part of the camera, and is lowered to such an

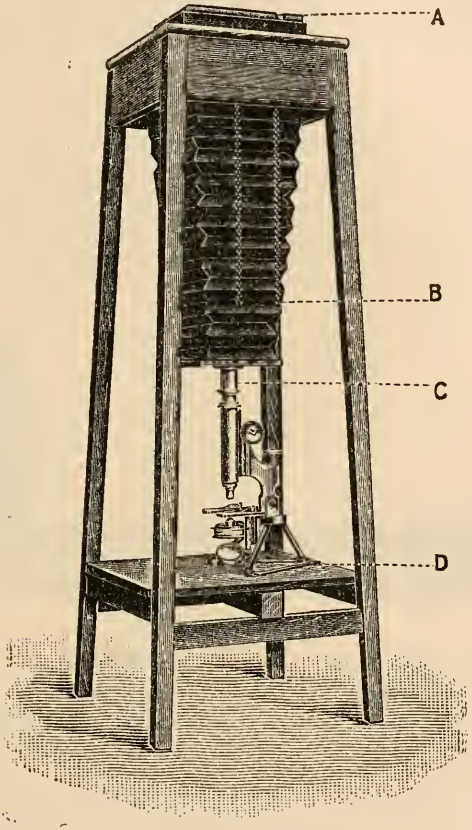



FIG. 42.

extent as to allow the operator to stand comfortably on the floor. This camera-stand is placed on the floor, close to the laboratory table. An approximately parallel beam of light is thrown across the lower shelf of the instrument from an ordinary optical lantern occupying a low independent stand, and from which the projection front has been removed. The most satisfactory light-source was found to be the oxy-hydrogen jet, but an incandescent gas-burner is good for at least the lower powers. The total height to the focussing screen is 46 in. but could be varied to suit different observers. From the eye-piece to the sensitive plate is 24 in. The top is a square of 12 in. side with a centre fitting for a

half-plate dark slide A. B is a pair of light brass chains which engage with hooks on the opposite side of the frame, and by which the camera-bellows may be supported when not in use. C is the brass union between the eye-piece and the bellows ; D, two guides into which the base of the Microscope fits.

HERSCHEL, SIR W. J.—**Colour Photography.**
[Gives a sketch of Ives' and Sanger Shepherd's methods.]
*Brit. Journ. of Photog.*, July 12, 1901, pp. 439–41 (3 coloured pls.);
*Ann. Rep. Smithsonian Institute*, 1901, pp. 313–6.

### (5) Microscopical Optics and Manipulation.

**Leiss' New Crystal Refractometer for the Determination of the Refractive Index of Large and Microscopically Small Objects.***—This instrument, designed by C. Leiss, is intended to apply to small crystals, as well as to mineral plates enclosed in thin sections. It may be considered as an improvement of the refractometer of C. Klein.† Two essentials of construction are :—(1) The association of the instrument

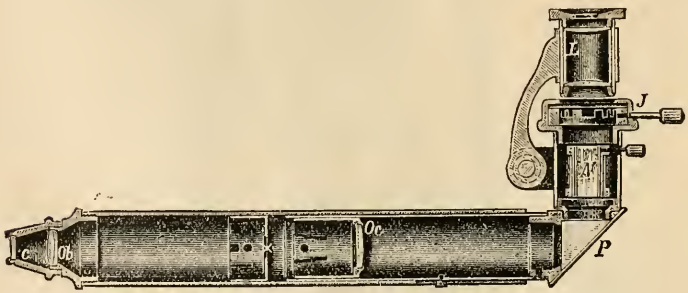



FIG. 43.

with a Microscope ; (2) the stopping-out of all disturbing light. The Microscope (or telescope) is shown in fig. 43 ; for convenience of observation it is made with an elbow. O*b* is the objective whose focal plane is marked X ; O*c* is the single-lens ocular ; P, the totally reflecting prism ; N, a nicol which can be inserted at pleasure and can be rotated by a small knob ; J is the iris diaphragm placed at the Ramsden circle of the ocular ; L is an observation lens, as recommended by Czapski and Pulfrich, formed of two lenses, adjustable in a sleeve and, by means of a hinged arm, quickly applied to the iris or removed. The lens *c* in front of objective O*b* is the well-known correction lens, which parallelises the beams emergent from the hemisphere, The application of the loup L makes the telescope into a Microscope of small magnification, and with it the preparation can be viewed not only from above (through the air) but also from below (through the hemisphere). A proper selection of lenses enables this to be done without special correction or change in the adjustment of the Microscope. When the loup L is removed, the *telescope* gives a magnification of $1\frac{1}{4}$ ; when the loup is applied the

* Zeitschr. f. Instrumentenk., xxii. (1902) pp. 331–4 (3 figs.).
† S.B. Berl. Akad., 1902, pp. 113 and 653.

*Microscope* magnifies 10 diameters. The *Microscope* having been arranged, the preparation is moistened with some strongly refracting liquid and hand-centred; the iris rotated to cut off all superfluous light so that only the preparation to be measured is visible through the Microscope. Whether the object is viewed from above or below it is well to illuminate it with the usual mirror. When the loup is removed the limiting angle is viewed with the telescope.

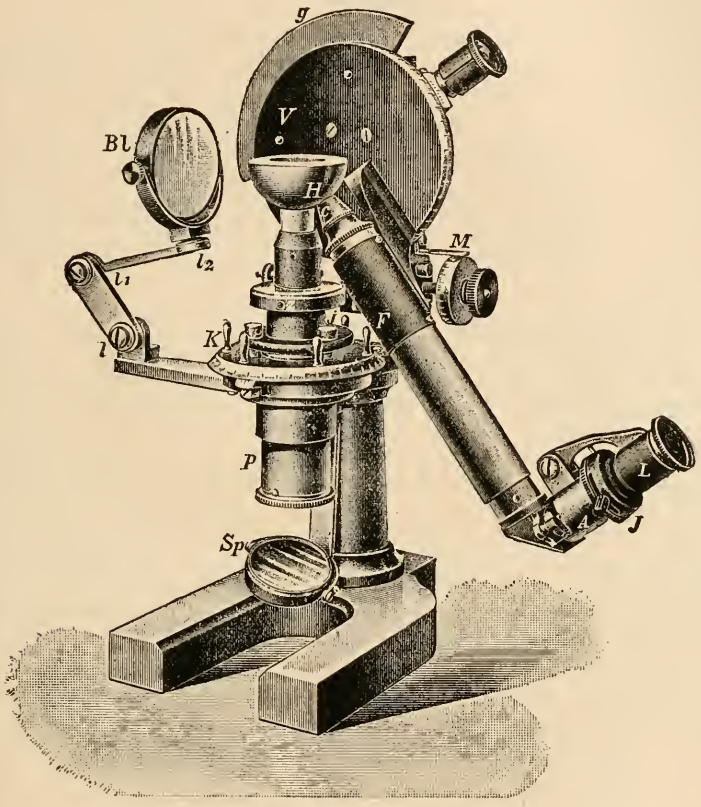



FIG. 44.

The general appearance of the instrument is shown in fig. 44. In the stage-plate, carried on a pillar set on the horseshoe foot, is a rotatory horizontal circle graduated in degrees. Above, it bears a perforated prolongation on which the hemisphere H is situated. The screws *z* and *j* respectively centre and adjust the hemisphere. *Sp* is the mirror for the under illumination. In the tube P, just above the mirror, is the nicol polariser adjustable, by means of its sleeve, in the three positions of 0°, 45°, 90°. The vertical circle V, on which the telescope (or Microscope) is affixed, is graduated into half degrees, and by means of

a vernier lens can be read to minutes. The graduation of the circle is from 0° to 100°; but there is a mark on the circle which must coincide with the vernier-zero when the Microscope is to be vertical. The micrometer-screw M has a pitch of 0·5 mm.; and its drum is, for dispersion measurements, divided into 150°.

**Michelson Echelon Diffraction Grating.***—This apparatus consists of a series of clear glass plates, each 10 mm. thick, overlapping in such a way as to form a series of "steps" each 1 mm. wide. The plates are all optically worked and should be in perfect optical contact; there may be fourteen or more mounted in a frame. A beam of parallel rays transmitted through the series of plates is, therefore, retarded by $n\,t$ mm., where $n$ is the number of plates and $t$ their thickness. On emergence the rays are in a condition to interfere. Though the echelon can be used with almost any form of spectroscope, a special form known as the "Constant Deviation Spectroscope" is the most convenient; the chief advantage of which is that neither collimator nor telescope is ever moved, the echelon being rotated as required. Spectra of various orders can be obtained in this way and are remarkable for their brilliancy. Numerous practical details and other information are furnished.

**Visibility of Ultra-Microscopic Particles.**†—In the course of an optical investigation of various shades of ruby glass, H. Siedentopf and R. Zsigmondy devised a method of observing small particles of gold which closely approach molecular dimensions, and thus extending our range of molecular vision very considerably. The ruby glasses, examined by the best ordinary Microscopes, appeared perfectly homogeneous. But the authors reasoned that if the gold particles imbedded in the glass were at such distances apart that a Microscope could resolve them, they could be made visible even though their size should be a small fraction of the wave-length of visible light. The only condition was that the product of the specific intensity into the surface of the luminous particles and the square of the sine of the effective angle of illumination should be greater than the inferior limit of the sensitiveness of the human eye. The problem is thus reduced to that of the visibility of a fixed star. What is seen is, of course, a diffraction disc, and that is all we can hope to see, but the authors indicate a means of determining the true size and weight of the particles seen.

It is essential that all disturbing side-lights should be avoided. The authors threw a beam of sunlight through a condenser on a slit 0·05 to 0·5 mm. wide, and an image of the slit was produced in the field of vision by a telescope lens and a collimator with a reduction of 36 diameters. The diffraction discs seen in the ruby glass had an average apparent diameter of 1 mm., while their real diameter, calculated from the quantity of gold present and the number of particles counted in unit volume, was 0·02 $\mu$ on the average. This gives a magnification of 50,000 diameters. The utmost limit to which the magnification can be pushed by this method is about 150,000 diameters, or 6 $\mu\mu$. The average diameter of a molecule being 0·6 $\mu\mu$, it cannot

* Pamphlet by Adam Hilger, 75A Camden Road, N.W., July 1901.

† Nature, lxvii. (1903) p. 380. See Ann. d. Physik, No. 1 (1903) pp. 1-39.

be seen, even as a diffraction disc, unless its specific luminosity were ten times that of the solar molecules, or the sensitiveness of the eye were greatly increased. The cumulative effects used in photography may be resorted to, but the authors do not mention that possibility.

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Method of Detecting the Presence of Bacillus coli communis in Shellfish.†** — In an article on the bacterioscopic diagnosis of sewage pollution of shellfish, E. Klein describes the method he adopted for detecting the presence of *B. coli communis* in cockles and oysters. Of each batch of cockles, 12 to 24 individuals were examined, and of each batch or sample of oysters, 10, 12, and sometimes 16 or 18 individuals. In all cases the shell of the fresh and living mollusc was thoroughly brushed with a clean brush under the running tap; then it was dried with clean cloth, opened with sterile instrument, and with the juice and liquor within the shell, cultures were established. Of each of six or eight oysters, about $\frac{1}{5}$ c.cm. of this liquor was added to one MacConkey tube and the same amount to one lactose tube; of further two, sometimes four, oysters, $\frac{1}{5}$ c.cm. of this liquor was added to each of two, or in some cases four, phenol-broth tubes, or in lieu (in the earlier analyses) about three big drops of the juice of each of two animals to establish two litmus-glucose-agar surface plates. Next day, that is, after twenty-four hours' incubation at 37° C., the necessary subcultures were made from the original tubes and plates in order to demonstrate the presence of *B. coli communis*; streak and shake gelatin cultures, MacConkey and lactose-pepton tubes, litmus-milk, ordinary broth (with and without neutral-red), litmus, lactose-phenol-agar plates, &c. From the turbid phenol broth also microscopic specimens stained by Gram's method were made in order to detect the streptococci. Cultures on solid media may also be employed for their detection.

Bosse, B.—**Der Deyckesche Pepsin-Trypsin-Agar ein Nährboden für Diphtheriebacillen.** *Centralbl. Bakt.*, 1te Abt. Orig., XXXIII. (1903) pp. 471-9.

Brongersma, S. H., & Th. H. Van de Velde—**Cultivation of Gonococcus on "Thalmann-Agar."**
[Observations confirming Thalmann's results.]
See this *Journal*, 1900, p. 613.

### (2) Preparing Objects.

**Fixation of Blood-Films and the Triacid Stain.‡**—E. S. Nutting has used for some time past Merck's methyl-alcohol for fixing blood-films. The preparations are treated with the reagent for three minutes, and then with the triacid stain for five minutes. Though the results

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous

† Brit. Med. Journ., 1903, i. 417-20. ‡ Tom. cit., p. 196.

are not so brilliant as when the films are fixed at a temperature of 150° C., they are generally extremely satisfactory.

**Simple Device for Carrying Minute Objects through the Grades of Cedar Oil and Paraffin.***—C. S. Gage transfers from one grade of cedar oil and paraffin to another by inclosing the object (pollinia of *Asclepias*) in little bags, made by bringing together the four corners of a square (1·5 in. by 1·5 in.) of cheese-cloth and fastening them by one or two turns of small copper wire. One end of the wire is left about one inch long and hooked at the free end. The bags can be suspended by the hooks in the bottles of oil and paraffin and thence transferred from one to another. When the imbedding stage is reached, the bags are cut from the wires, opened in the melted paraffin, and the pollinia distributed as desired. By this device excessive handling is avoided.

### (3) Cutting, including Imbedding and Microtomes.

**Jung's New Student's Microtome.**†—The frame *g* of R. Jung's new pattern student's microtome (figs. 45 and 46) is fixed to the table by means of a screw-clamp K*n*. To the upright piece *a* which moves on two screw-points *s s*, are attached the handle H and the knife-

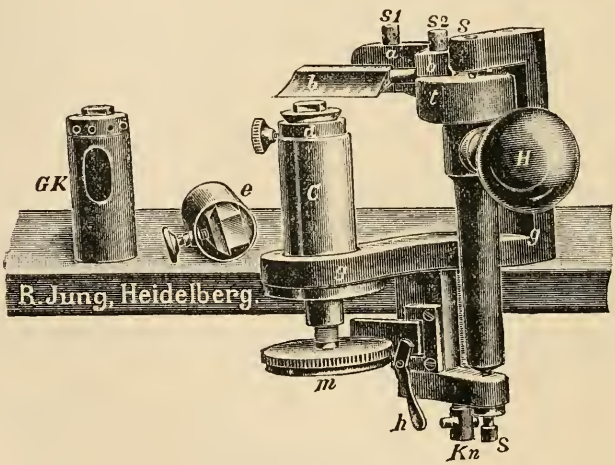



Fig. 45.

carrier *t* with its clamping jaws *a* and *b*. To the base of *g* are fitted the micrometer-screw *m* and the tube C, which serves as sleeve for the object-holder and the freezing apparatus. The instrument can be used

* Journ. App. Micr., vi. (1903) p. 2115.

† R. Jung's Catalogue, 1902 (2 figs.); also Zeitschr. angew. Mikr., viii. (1902) pp. 236-43 (2 figs.).

for cutting sections of fresh tissue without imbedding, of tissue frozen by means of ethyl chloride, and of material imbedded in paraffin and celloidin.

In fig. 45 the instrument is shown with ratchet and pawl adjustment, with clamp for paraffin block, and apparatus for freezing with

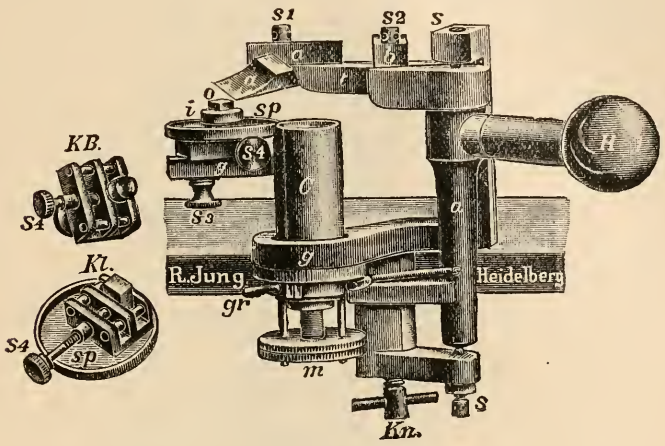



Fig. 46.

ethyl chloride. In fig. 46 the instrument is shown with obliquely placed knife, the position adapted for cutting celloidin sections and fresh hard objects. The apparatus is well supplied with the accessories necessary for fixing and holding the objects to be cut, and knives suitable for sectioning according to the method of imbedding. Full directions are given for manipulating the machine, how to set and strop the knives, and the best way to fix the knife for cutting.

**Sectioning Fresh Plant-Tissues.*** — N. B. Pierce presses a small piece of leaf or other like tissue between two flat cakes of paraffin, each being 20 mm. long, 14 mm. wide, and 3 mm. thick, taking care that the margins of the blocks coincide. A heated scalpel is then run round the edges of the blocks so as to melt them together where touched. The block is then cooled in water until it is sufficiently firm to be fixed to the microtome block and trimmed in the usual manner. In this way excellent sections, 5 $\mu$ thick, can be obtained of perfectly fresh tissue.

**Improvement in Reichert's Sliding Microtome.**† — J. Starlinger describes this new arrangement, which is clearly recognisable from fig. 47. It concerns the mechanism of the knife-slide and is intended to make it independent of the direction of gear rotation. Hitherto, the windlass H and chain have been in intimate connection, and every

* Journ. App. Micr., v. (1902) pp. 2074–5.
† Zeitschr. f. wiss. Mikr., xix. (1902) pp. 145–7 (1 fig.).

rotation of the former produced a corresponding movement in the latter. Now, between these there are placed a larger (*b*) and two smaller toothed wheels (*h*, *i*), as well as another toothed segment-piece *d* ex-

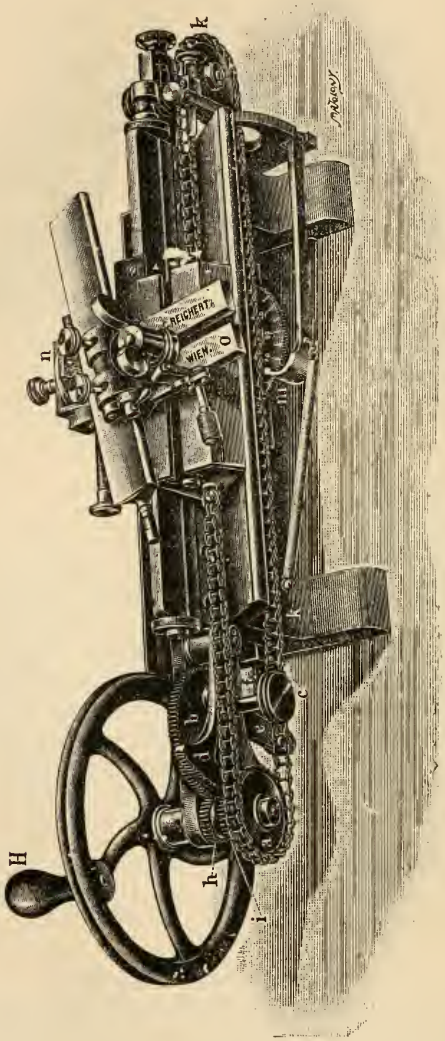



FIG. 47.

centrically connected with *b* by means of the lever *e*. The wheel *h* engages with H, and *i* engages with the chain-wheel *a*. The successive transmission of movement is through the toothed wheel *b*, the lever-

arm *e*, and the toothed segment *d*. By means of the excentrically applied lever the circular movement of the segment *d* is converted into an up-and-down movement, which afterwards causes the forward and backward rotation of the wheel *i*, and finally the forward and backward gliding of the knife. The connection of *d* and *e* is adjustable and can be regulated in such a way that the knife movement may extend over the whole, or part, of the slide-range. The author considers that the operator will find it an advantage to be able to rotate the wheel H as he pleases, and that the application of motor-gear to the microtome will be facilitated.

**New Method of Imbedding Small Objects.*** — G. Lefevre has devised a glass dish in which small objects, e.g. Echinoderm eggs, &c. may be imbedded with great ease, and which prevents them from

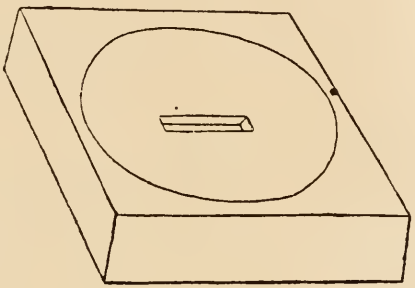


Fig. 48.

scattering. The dish is a flat solid watch-glass with a shallow concavity, in the bottom of which is moulded a narrow slot-like groove or trough (fig. 48). The dish is 40 mm. square and 9 mm. high ; the

Fig. 49.

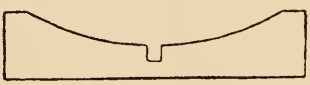


Fig. 50.

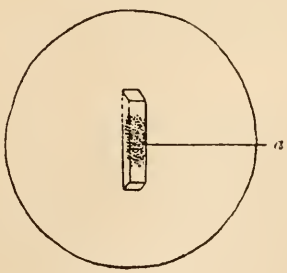



Fig. 51.

diameter of the concavity is 34 mm. and its greatest depth 4½ mm. The groove, which is slightly bevelled at the ends, is 11 mm. long at the bottom, 2 mm. wide, and 2 mm. deep. Fig. 49 shows a section

* Journ. App. Micr., v. (1902) pp. 2080–1 (5 figs.).

of the glass through the long axis of the groove, and fig. 50 a section across the groove.

When the objects are ready for imbedding, they are transferred to the dish filled with melted paraffin and kept warm on the bath, by carefully dropping them from a pipette into the groove. The bottom of the dish is then rapidly cooled. When thoroughly hardened the paraffin may be removed without difficulty, and it then has the form seen in fig. 51.

**New Razor-holder and Adjustable Clamp for the Minot Microtome.***—S. H. Gage advises the use of a razor with a straight edge and back. This is fitted in a support which will allow nearly the whole length of the cutting edge to be used, and which consists of a piece of brass resting on the knife-support of the microtome. At right angles to the base-piece on which rests the back of the razor, is a vertical back-piece against which the side of the razor rests. This is slightly narrower than the width of the razor-blade, and a notch is cut out of the middle where the sections are made. A front-piece is made like the back-piece, except that it is not fastened to the base-piece. This is put against the front side of the razor and the clamping screws of the regular knife-holder press against it.

As the Minot holders for the paraffin blocks have but very slight adjustment and are, moreover, somewhat expensive, short stove blocks were recommended to meet the requirements of a large class. But as these did not fit very often, an adjustable clamp was devised which will receive bolts differing 1 or 2 mm. in diameter. The stem which connects the clamp of the microtome has a long thread, and a solid piece is screwed upon it. A loose piece like the first is then slipped over the screw, and finally a thumb-nut is put upon the end to press the loose piece against the fixed piece. Holes are bored in the clamp, half the cylinder being in each. Either of these holes serves for the paraffin block holder. Such a clamp surmounts the difficulties of variations in the size of the stem of the paraffin holder.

Dixon, H. H.—**Sectioning without Imbedding.**
*Bot. School T. C. Dublin*, Aug. 1902.

### (4) Staining and Injecting.

**Staining Directions for Photomicrography.**†—F. Crosbie remarks that the stains selected in micrography often throw great difficulties in the way of the photographer, rendering it impossible to obtain really good negatives and necessitating the use of light-filters of great depth of colour, with a corresponding diminution of actinic light-value and an increase in the length of exposure. When it is known that a specimen is to be photographed the stain should be specially selected with a view to this if possible. Hæmatoxylin is suitable for sections. Gentian-violet gives the best results with bacteria. Fuchsin should be avoided. In fact, it can be roughly stated that all stains on the blue or violet side of the spectrum answer best, and stains belonging to the red

* Trans. Amer. Micr. Soc., xxiii. (1902) pp. 259-61 (1 pl. and 7 figs.).
† Lancet, 1903, i. pp. 233-6 (5 figs.).

end of the spectrum give the worst results. Golgi preparations give most satisfactory negatives. Sections stained with hæmatoxylin or other blue dyes are very actinic, and it is necessary to exaggerate the shadow thrown by them. This is done by colouring the light before it enters the condenser of the Microscope, with a light filter or colour screen of a tint complementary to the stain. In most cases the screen sold by photographic dealers for landscape photography will be found sufficient; this is a light brown-yellow glass screen. Should the section be thin and the staining slight or faded, greater depth of colour will be necessary in the light-filter. This can be obtained by staining a film of gelatin on a glass plate with picric acid, or, better still, by using a glass trough or bottle filled with a solution of bichromate of potassium. The light-filter, however constructed, must be placed between the light and the Microscope. If a coloured glass screen, it is fitted into a frame which is hinged to the platform on which the Microscope stands, so that it can be raised or lowered at discretion. To this frame is also hinged a sheet of vulcanite, in order to cut off all light from the Microscope when manipulating the dark slide before and after making an exposure.

If possible, all preparations of a series to be photographed should be stained with the same dye, as this will simplify the calculations necessary to find the time of exposure, will suit one quality of plate and one light-filter, and will render possible an exact comparison of the various results and a correct relation of their several details.

**Method of Demonstrating the Secretory Canaliculi in Suprarenal Capsules.*** — C. Ciaccio fixed the fresh tissue for 15 to 20 days in Müller's fluid and then transferred the pieces to a 1 p.c. solution of nitrate of silver for 24 hours. Better results were obtained by fixing in the following mixture :—Formalin 15 c.cm.; bichromate of potassium 5 grm.; distilled water 100 c.cm. Good preparations may be obtained by cutting sections with a razor from the pieces directly removed from the silver nitrate, but paraffin sections were necessary for demonstrating the more delicate details. The sections were stained with acid fuchsin, by Zimmermann's silver chloride method, and in other ways. The animals used were guinea-pigs, rabbits, and cats. By this procedure pericellular canals having intracellular ramifications were demonstrated.

**Staining Diphtheria Bacilli and Cholera Vibrios.†** — W. G. Schauffler, in a preliminary communication, states that by means of Loeffler's methylen-blue, pyronin, and hydrochloric acid-alcohol, diphtheria bacilli from fresh membrane, or from cultures, stain easily and without the aid of heat. The poles appear red, while the rest of the cell-body is stained blue. Pure cultures of different races of cholera vibrios show on staining with methylen-blue, decolorising with hydrochloric acid-alcohol and contrast-staining with dilute pyronin, dark granules in the bluish-red bodies.

**New Method of Staining Flagella.‡** — E. Gemelli describes the following method for staining flagella. The cover-glasses are boiled in

* Anat. Anzeig., xxii. (1903) pp. 493–7 (3 figs.).

† Allg. Med. Central-Ztg., 1902, p. 827. See Centralbl. Bakt., 1te Abt. Ref., xxxii. (1903) p. 687. ‡ Centralbl. Bakt., 1te Abt. Orig., xxxiii. (1903) pp. 316–9.

a solution consisting of 3 p.c. potassium bichromate and sulphuric acid (100 : 5), and after having been washed in water are kept in alcohol. When required for use they are picked up with horn-tipped forceps and flamed. The material used should be obtained from fresh cultures. The best are those which are solid, contain little salt, and are prepared with glycerin. A loopful of culture is placed on a watch-glass containing 5 c.cm. of distilled water, and a drop of the suspension spread over the cleaned cover-glass. The cover-glass is then placed under a bell-jar and allowed to dry slowly with the aid of calcium chloride. For staining, two solutions are required : (*a*) potassium permanganate 25 cg., distilled water 10 grm. (*b*) To a calcium chloride solution (0·75 grm. in distilled water 100 grm.) in the proportion of 20 to 1 is added a 1 p.c. solution of neutral red. The cover-glass is then laid in the potassium permanganate solution for 10 to 20 minutes, and after having been washed in distilled water is transferred to the neutral red solution for 15, 20, or 30 minutes, according to the kind of bacterium dealt with. The cover-glasses are then washed, dried with blotting-paper, and mounted in balsam.

**Staining the Reticular supporting Network of Malignant Neoplasms by Mallory's Method.***—P. G. Woolley recommended that sections should be cut from tissue hardened in Zenker's fluid and imbedded in paraffin. These are fixed to the slide in the usual way, and then the paraffin is dissolved off and the slide immersed in absolute alcohol, 95 p.c. alcohol, 70 p.c. alcohol, then in water. Next, the sections are stained in a $\frac{1}{10}$ p.c. aqueous acid fuchsin solution for 2–3 minutes and then washed in water. After this, the sections are treated for 5–7 minutes with a few drops of 1 p.c. solution of phospho-molybdic acid. After again washing in water the sections are stained with a solution composed of anilin-blue 0·5 grm., orange G 0·2 grm., oxalic acid 2 grm., water 100 c.cm. This is allowed to act for about 20 minutes, after which the slides are rinsed in water and then hurriedly dehydrated with 95 p.c. alcohol. Finally, the sections are treated with a drop or two of anilin oil which is allowed to remain on until the sections are clear. It is then removed with blotting-paper, and the sections having been treated with xylol are mounted in balsam. By this method the finest reticular processes can be seen clearly and distinctly.

**Staining Reactions of Proteid Crystals.**†—J. A. Milroy finds that albumin crystals, prepared by the method of Hopkins and Pinkus, after treatment with trichloracetic acid have a selective affinity for acid as distinguished from basic anilin dyes. If, however, they are further treated with alcohol they become capable of taking up either acid or basic dyes. In the latter case the staining is to be regarded as a physical phenomenon, while in the former it is largely chemical.

**Improved Method for the Microscopical Diagnosis of Intermittent Fever.**‡—Ronald Ross recommends the following method by which a thick film of blood is treated in a manner which does away with

* Johns Hopkins Hosp. Bull., xiv. (1903) pp. 21–4 (3 figs.).
† Proc. Scot. Micr. Soc., iii. (1901–1902) pp. 252–7.
‡ Lancet, 1903, i. p. 86.

the obscuring effect of the massed corpuscles. The method depends on the fact that the parasites adhere to the stromata of the containing capsules, after the hæmoglobin has been washed out of the films. A thickish film of blood is spread on a slide over an area which can be covered by the ordinary slip. It is then dried in the air or over the flame. The dried film is then covered with aqueous solution of eosin which is allowed to act for about a quarter of an hour. The film is then gently washed to remove the superfluous eosin and at the same time the hæmoglobin. The film is then treated with a weak solution of methylen-blue for a few seconds. After washing the film it is dried and mounted in balsam. Prepared in this way the films show about twenty times the number of parasites as are found in preparations of the same blood made in the ordinary way.

**Method for Demonstrating Nematocyst Cells in Hydra.***—E. O. Little puts living hydras in a Stender dish with a small amount of water. A boiling-hot mixture of saturated solution of sublimate in 70 p.c. alcohol is then poured into the dish. This kills the hydras in full extension. After washing several times in 70 p.c. alcohol, the animals are passed through 50 p.c. alcohol, 35 p.c. alcohol, and water successively, after which they are stained for 5 minutes in the following solution :— Methylen-blue 1 grm., Castile soap 0·5 grm., water 300 c.cm. The animals are then passed hurriedly through the alcohols of the following strengths : 30, 50, 70, 85, 90, 100 p.c., then cleared in cedar or bergamot oil and mounted in balsam. The nematocyst cells are stained deep blue, all other cells are unstained ; exploded nematocyst cells do not stain.

**New Method of Staining Bacterial Granules.†**—M. Ficker recommends a staining solution consisting of methylen-blue Höchst 1–10,000, lactic acid 2 p.c. The solution is made by dissolving 1 grm. of methylen-blue in 100 c.cm. of distilled water and mixing 1 c.cm. thereof with 100 c.cm. of distilled water. To 100 c.cm. of the last solution 2 c.cm. of lactic acid are added. With this staining solution a fresh unfixed bacterial suspension, placed on a slide and covered with a slip, is treated by sucking the stain through with the aid of blotting-paper and repeating the process several times if necessary. By this procedure two or three dark blue granules appear, the rest of the bacterial cell remaining unstained.

**Easy Method of Staining the Flagella of Bacteria.‡**—G. L. Valenti says that just as good results can be obtained from gelatin, potato and bouillon cultures, as from young agar cultures. The films are prepared from emulsions in the usual way, and when carefully dried may be kept for months before being used. The mordant used is a 20 p.c. solution of tannic acid in distilled water, and the staining solution Ziehl's fuchsin. The point of the method is to mix the mordant and staining solution. The film is just covered with the mordant, then three drops of the Ziehl's fuchsin solution are added. The cover-glass or slide is then heated, and after having cooled is washed with water, dried, and mounted in balsam.

* Journ. App. Micr., vi. (1903) p. 2116.

† Hygien. Rundschau, 1902, p. 1131. See Centralbl. Bakt., 1te Abt. Ref., xxxii. (1903) p. 723.

‡ Centralbl. Bakt., 1te Abt. Ref., xxxii. (1903) pp. 744-6.

**Apparatus for Facilitating the Manipulation of Celloidin Sections.** R. Hamlyn-Harris writes that anyone who has had experience in preparing, staining, and mounting a series of celloidin sections will have appreciated the difficulties of manipulation and of keeping each section in its proper order and of staining each uniformly. It was while considering this subject, and having to deal with an object, the individual sections of which had to be carefully mounted in successive order, that the apparatus (fig. 52) suggested itself to the writer's mind.

It will not be difficult to gather from the illustration that the apparatus consists of separate compartments, each of which represents a cell capable of holding one or more sections. These are handled either by a small brush moistened in 80 p.c. alcohol, or by an ordinary section-

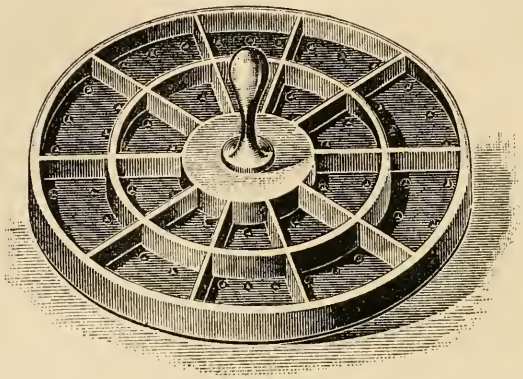


Fig. 52.

lifter, and placed into each cell successively. The whole apparatus and contents can then be submerged in 80 p.c. alcohol until wanted.

By means of the handle the whole appliance can be taken out of one kind of fluid and placed in another without moving the sections from their respective cells. Care is needful that they do not get washed out of the partitions in the transfer from one fluid to another. This may be prevented by the use of a small brush, and should any section rise to the surface, it can be easily replaced in position. The body of the appliance is formed of one piece of a non-corroding metal, while the bottom is made of brass. The diameter of the apparatus is $3\frac{1}{2}$ in.; the plate is $\frac{3}{16}$-in. thick and the partitions $\frac{1}{8}$-in. thick. Measured from the outside the height of the sides is $\frac{1}{8}$ in. and that of the handle $\frac{5}{8}$ in. The handle can be unscrewed and removed. In each compartment there is a perforation to allow the fluid to escape when the transfer is made from one fluid to another.

No further description is necessary as every microscopist will see at once the advantages claimed for the invention. It has been exceedingly useful to the writer and he hopes it may be of service to others. If the apparatus were made in a square form and if suitable glass vessels could be got to fit it, a greater advantage would result, as space for several

more compartments would thereby be gained. The appliance described possesses twenty compartments, but from experience I have found that this number is sufficient. Could some transparent substance, such as glass or mica, be used in its construction, so as to enable differentiation to be carried out under the Microscope, it would be a great boon, but all attempts to get this accomplished have so far failed.

DIETERICHS, K.—**Mikroskopische Technik des Zentralnervensystems.**
[A review of general methods, of special methods of staining nerve-cells, medullary sheaths, axis-cylinders, neuroglia, and nuclei.]
*Zeitschr. angew. Mikr.*, VIII. (1902) pp. 225–36.

EHRLICH, P., R. KRAUSE, M. MOSSE, H. ROZIN, & C. WEIGERT—**Encyclopädie der mikroskopischen Technik mit besonderer Berücksichtigung der Färbelehre.** Parts i. and ii., with numerous illustrations.
Berlin and Vienna, 1903.

GRIMME, A.—**Die wichtigsten Methoden der Bakterienfärbung in ihrer Wirkung auf die Membran, den Protoplasten und die Einschlüsse der Bakterienzelle.**
*Centralbl. Bakt.*, 1te Abt. Orig., XXXII. (1902) pp. 1–16, 81–90, 161–80, 241–55, 321–7 (2 pls.).

### (5) Mounting, including Slides, Preservative Fluids, &c.

**Slide for Pond Life.***—S. E. Dowdy describes a convenient slide for studying the life-histories of aquatic microscopic organisms and pond life in general, similar in principle to Botterill's. It may be constructed as follows. Select a vulcanite cell-ring of small diameter and medium thickness, and cut it in half. Cement the two portions with gold size or coaguline in the centre of a 3 by 1 in. slide, so that a narrow channel is left on each side of the circle (fig. 53). Pick out


FIG. 53.

a cell-ring of sufficient diameter to just encircle the other and rather thicker than the first one. Cement this down round the other and notch out the portions resting against the channels in the inner ring. A thin circular cover-glass which will just fit into the larger cell-ring completes the arrangement.

Fresh water can be put in on one side with a pipette and any excess drawn up at the opposite channel with a roll of blotting-paper. The cover-glass can be lifted easily by inserting a needle under it through one of the small openings. A slide of this description can be utilised also in bacteriological work for studying hanging-drop cultivations, excess of air, if necessary, being prevented by painting round the edges of the cover-glass with vaseline.

* Engl. Mech., lxxvii. (1903) p. 13 (1 fig.).

### (6) Miscellaneous.

**Biological Laboratory Methods.***—P. H. Mell's text-book, though specially intended for the use of students in biological laboratories, will be found extremely serviceable by workers with the Microscope in other branches of science. Its scope is highly practical and the information is conveyed in clear and simple language. The first three chapters deal with the Microscope, eye-pieces, objectives, and accessory apparatus. Then follow four chapters on the methods necessary for transforming a piece of soft tissue into its permanent condition of a stained and mounted section.

Much space is devoted to photomicrography, the apparatus and processes being described in considerable detail.

The last chapters deal with the apparatus and methods requisite for bacteriology, bleaching, decalcification, injection and maceration, the polarisation of light and its application to biological investigations; the work concluding with a copious supply of useful formulæ and tables, and an appendix on the arrangement of the laboratory and its furniture.

The volume is well got up, is of convenient size, and the illustrations are clear and frequent.

**Counting the Red Corpuscles of the Blood.**†—C. A. MacMunn showed at the meeting of the Physiological Society on January 17, lantern slides illustrating how the counting of the red corpuscles can be done by photographing fresh films. The blood is diluted to half or to 1 p.c. in the Thoma-Zeiss hæmocytometer. Not only are the red corpuscles seen on the plate but also the rulings of the cell-slide. The most suitable power was found to be a $\frac{3}{4}$ in. objective and a Zeiss eye-piece No. 4, with a 6-in. tube-length. This method enables a permanent record of blood-counts to be kept, and also to make the enumeration at any time. Of course, the Microscope and camera are used in the vertical position.

**Fusible Metal Stopper for Test-tubes.**‡—F. Glage recommends "fusible metal" for sealing up test-tubes as they are cleaner than resin or paraffin. The alloy melts on boiling water and when heated over the flame drops off like sealing-wax. If dropped on to a glass plate thin disks, about the size of a shilling, are formed. These disks are easily manipulated, and by the aid of a little heat made to fit over the mouth of test-tubes with great accuracy.

GREVILLIUS, A. Y.—**Keimapparat zur Erhaltung konstanter Feuchtigkeit im Keimbette während einer beliebig langen Zeit.**
*Beih. Bot. Centralbl.*, Orig.-Arb., XII. (1902) pp. 289-92 (1 fig.).

KAUSCH, O.—**Neuerungen auf dem Gebiete der Desinfektion und Sterilisation.**
*Centralbl. Bakt.*, 1te Abt. Ref., XXXII. (1903) Nos. 24 and 25.

* Macmillan & Co., London and New York, 1902, xii. and 321 pp. and 128 figs.
† Nature, lxvii. (1903) p. 327.
‡ Centralbl. Bakt., 1te Abt. Orig., xxxiii. (1903) p. 479.

## MICROSCOPY.

### A. Instruments, Accessories, &c.*

#### (1) Stands.

**Beck's Portable "Star" Microscope.**†—This instrument, called Stand No. 43 by the makers, is shown in fig. 54.

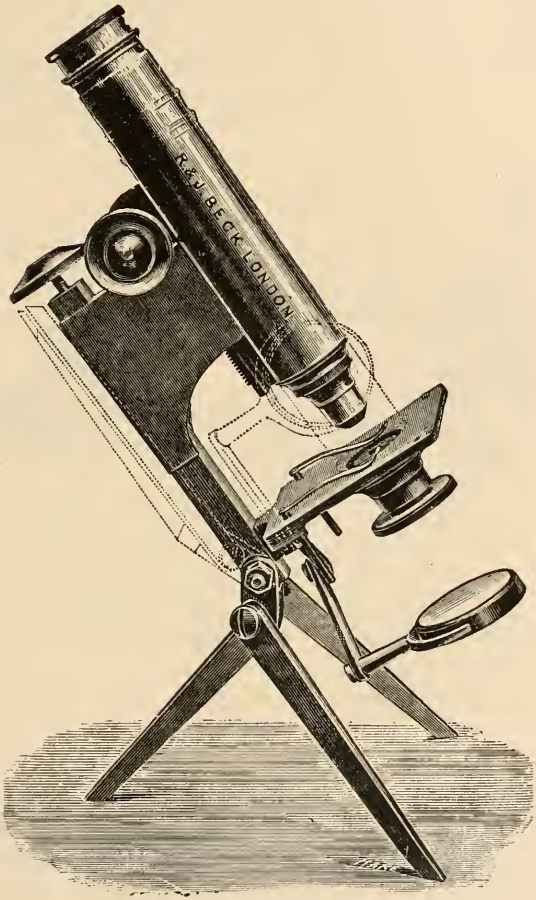



Fig. 54.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Messrs. R. and J. Beck's Catalogue, London, p. 18.

It has rack-and-pinion coarse adjustment, and the fine adjustment is by micrometer-screw. The base is a folding tripod with joint for inclination. It is furnished with draw-tube, double mirror, and iris diaphragm. The leather or walnut case, in which it is packed, measures only about $6\frac{1}{2}$ by $4\frac{1}{4}$ by $3\frac{1}{4}$ in.

**Beck's Process Microscope.***—The Microscope illustrated in fig. 55 is specially designed for the examination of "surfaces" in any branch of photo-mechanical work. It is very useful in examining the form of the dots in half-tone work and for watching the process of etching. It may also be used for ascertaining the grain of a collotype or for examining the three-colour work as it comes off the machine. The instrument has a rack-and-pinion movement for focussing with draw-tube. The illumination is provided by a jointed condenser, which can be made to

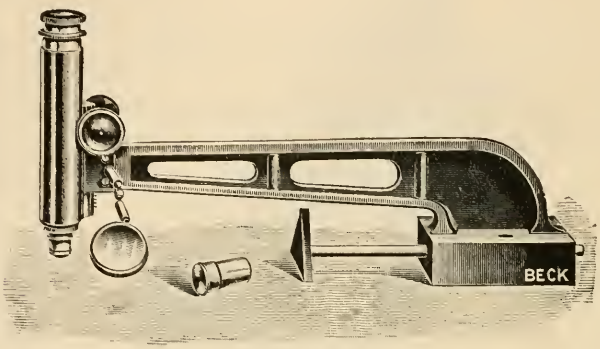



Fig. 55.

move in any direction. The Microscope, with its long arm and heavy base, can be used where desired; or it may be screwed to the bench and the plates passed under it.

**Beck's Pathological Microscope.**†—This is called Stand No. 17 by the makers, and is shown in fig. 56. The build is that of the tripod base and pillar model, and is as rigid and well balanced in the horizontal as in the vertical position. The coarse adjustment is by rack-and-pinion. The patent fine adjustment is by means of a lever actuated by double thread screws, which give the two speeds of $\frac{1}{50}$ in. and $\frac{1}{300}$ in. for one complete revolution of the milled head. The fine adjustment is so placed that it can be used without raising the wrist from the table. The mechanical stage has a 2-in. motion in the lateral direction and a 1-in. in the vertical. It is divided and engraved in $\frac{1}{50}$ in. for purposes of "finding." There is a spiral rack-and-pinion focussing and screw centring substage and a double mirror.

* Messrs. R. and J. Beck's Catalogue, London, p. 48.
† Tom. cit., p. 38.

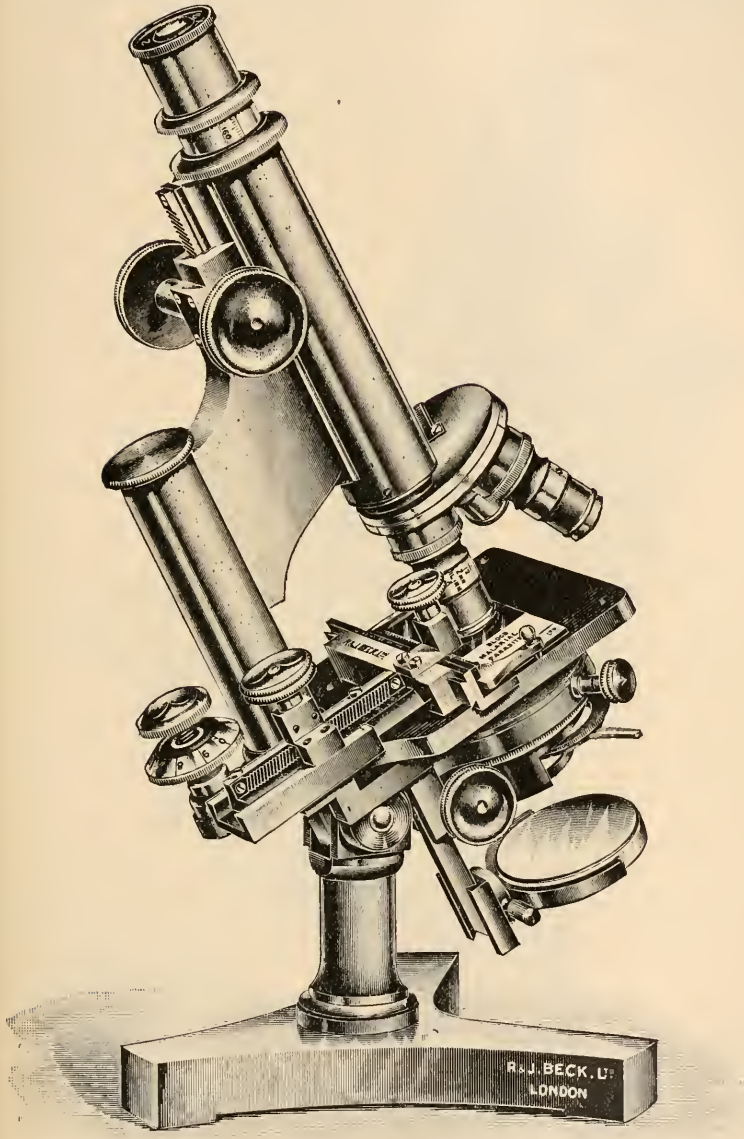



Fig. 56.

**Beck's Metallurgical Microscopes.***—The great desideratum in a metallurgical Microscope is a sufficient distance of stage from body to

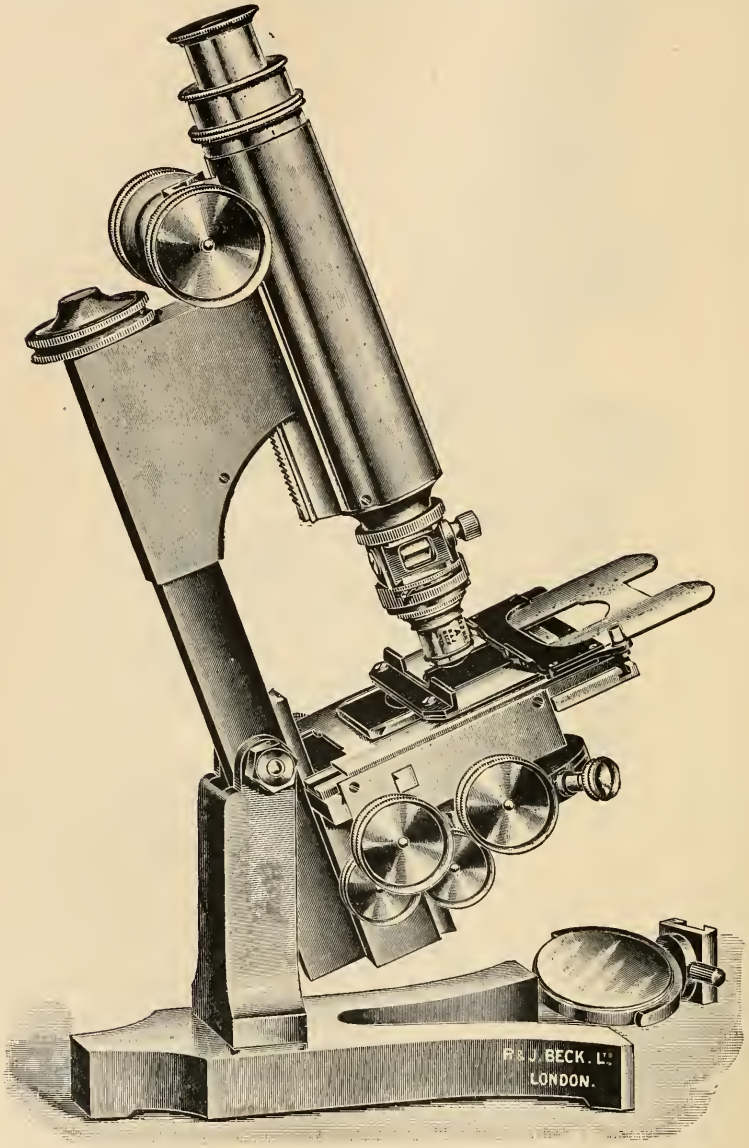



Fig. 57.

* Messrs. R. and J. Beck's Catalogue, London, p. 46.

permit the use of the observing prism and vertical illuminator at the same time. This is especially provided for in Stand No. 1154 (fig. 57), which has coarse and fine adjustments, inclination joint, and stage with mechanical motion in both directions. Rack-and-pinion adjustments are provided for raising and lowering the stage. The substage has rack-and-pinion focussing and centring adjustments. The same firm adapt their "Imperial" Microscopes for metallurgy by providing an adjustment for racking down the whole stage a distance of 2 in.

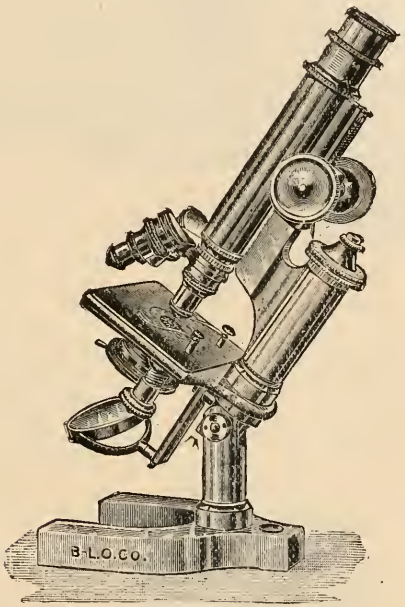



Fig. 58.

**Bausch and Lomb's Continental Microscope, BB Model.**—This instrument, which was exhibited and described by Mr. Rousselet at the March meeting (see p. 244), is shown in fig. 58.

### (3) Illuminating and other Apparatus.

**Koristka's Large Reflecting Mirror.***—This adjunct, which is shown in fig. 59, is intended to be used as a heliostat. It is then fixed outside the shutter of a dark room and the plane of the mirror so turned as to reflect the light through the tubular mount into the room. The screw-heads allow the slope of the plane to be corrected, from time to

* F. Koristka's Catalogue, Milan, fig. 65, p. 77. This mirror was originally invented by John Cuff, of Fleet Street, in 1743.

time, as required; they are operated from within the room. The size of the mirror is 11 by 33 cm.

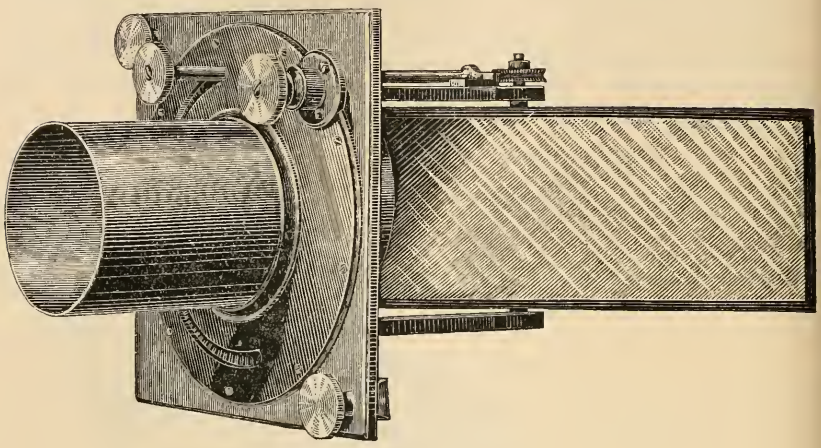


Fig. 59.

**New Electrical Microscope Lamp.***—H. Poll's apparatus (fig. 60) consists of a small electric incandescent lamp set in the interior of a parabolic hollow mirror. It is of 3 to 7 volts and 4 to 5 candle-power, and is of about the same size as the lamps used for cystoscopic purposes.

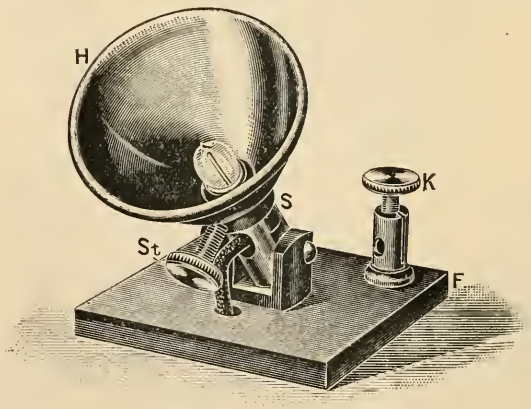



Fig. 60.

It works on the upper end of a pillar S, connected with the foot-plate F by means of a hinge. The foot-plate has two binding screws for bring-

* Zeitschr. f. wiss. Mikr., xviii. (1902) pp. 413–7 (1 fig.).

ing the instrument into circuit with an electric current obtained from a dry cell or other convenient source. The hollow mirror can be pushed up and down the pillar and clamped by a screw *St.* When the lamp-filament is brought into the focus of the mirror an intensely bright stream of parallel rays is directed outwards. The lamp can be set immediately under the condenser; or the Microscope mirror, if irremovable, can be set at a proper angle for receiving the light horizontally and reflecting it vertically upwards. A coloured disc can be set in the condenser if desired. Simple means are provided for regulating to a nicety the light-intensity. A bibliography on electric lamps is appended to the original article.*

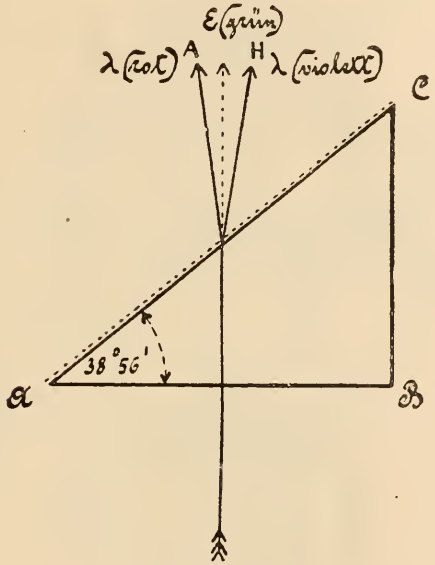



Fig. 61.

**Engelmann's Microspectral Objective with Detachable Thorp's Grating and Detachable Polariser.**†—The invention of the Thorp transparent grating has put a new agency at the disposal of spectroscope makers. The rulings are about 14,560 to an inch, and the intervals are 1·7 $\mu$. In consequence of this the perpendicularly incident principal rays in the first diffraction spectrum are deviated about 20° for central yellow. The application of such a transparent plane grating in the microspectral objective would have required a corresponding inclination

* As the rays from the electric lamp are divergent, and those from the parabolic mirror parallel, they cannot both be brought to a focus on the object, at the same time, by the substage condenser.—[Ed.]

† S.B. k. preuss. Akad. Wiss. zu Berlin, xxxi. (1902) pp. 711-9 (7 figs.).

of the collimator tube to the projection tube. This inconvenience is avoided by affixing the collodion grating to one of the faces of a glass prism. The glass used is boro-silicate-crown, O 144 of Schott's catalogue, with a refractive angle of 38° 56′. The rays proceeding from the collimator tube fall perpendicularly on the base A B of the right-angled prism A B C, fig. 61, and when refracted through the hypotenuse A C are simultaneously dispersed by the grating which is affixed to A C. [The angle B A C is 38° 56′.] The red end of the first diffraction

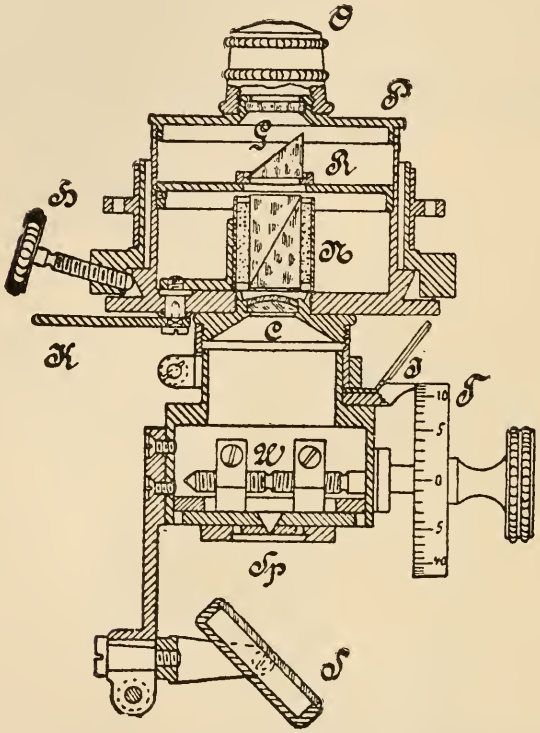



Fig. 62.

spectrum is towards the angle A, and the violet end towards C. A ray of medium wave-length (of perhaps 0·56 $\mu$) passes through undeviated. Fig. 62 gives in approximately natural size a sectional view of the apparatus. S*p* is the entrance slit whose width is regulated by a spindle provided with a left and a right-handed screw, and the graduations on the drum J give the width of the slit in hundredths of a millimeter. C is an achromatic collimator objective of 32 mm. focus and 6 mm. free aperture. Above this is a polariser N of Ahrens' construction, detachable by a lever K, thus allowing the use of the instrument as a spectro-

polariser. R is the prism with its film grating, and G a plane-parallel glass plate for protecting the prism chamber. By means of a lever the

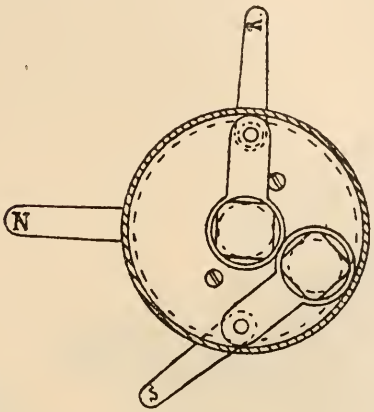



Fig. 63.

prism grating may be moved aside and a film-grating substituted for it. The whole is applied under the stage like a substage condenser.

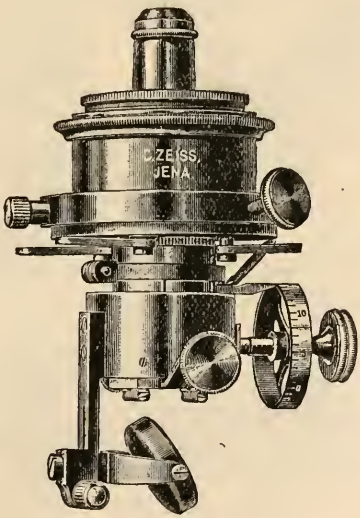



Fig. 64.

Fig. 63 shows the arrangement of levers for detaching the nicol N, the film-grating S, and the prism-grating R.

Fig. 64 shows the actual instrument full size ; fig. 65, fitted to Zeiss' stand 1$^{c}$.

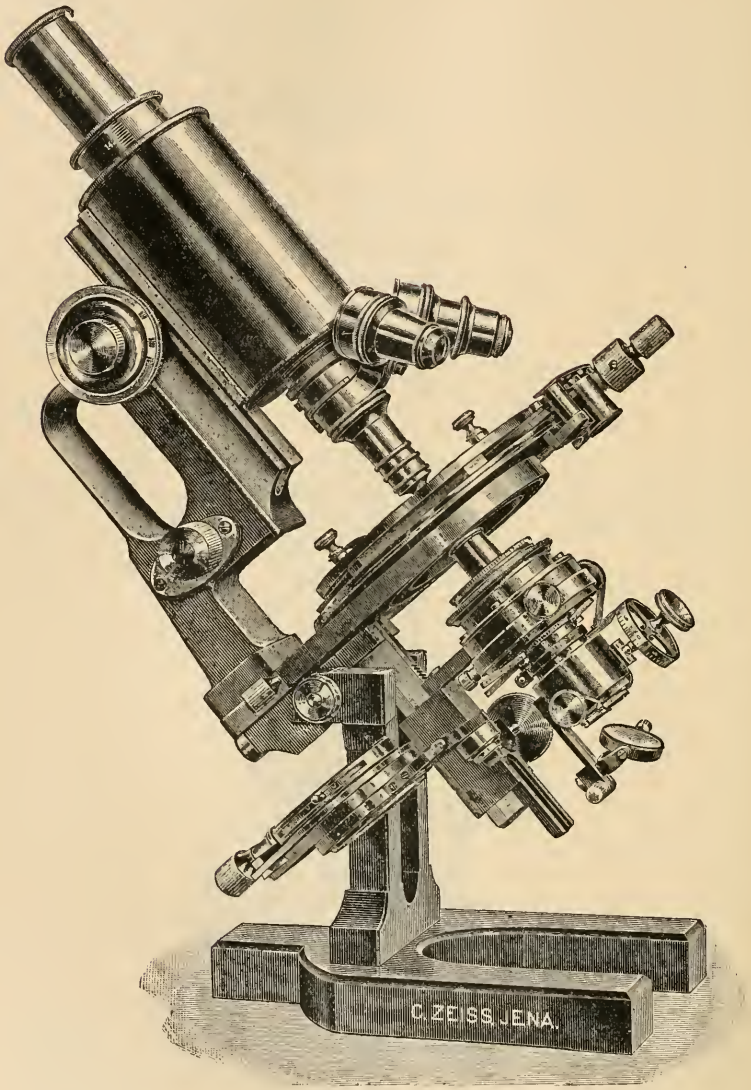



Fig. 65.

### (4) Photomicrography.

**Koristka's Simplified Vertical Camera.***—This design (fig. 66) is due to Professor Ruffini of Siena, and its nature will be easily understood from the figure. A handle at the top, connected with an endless screw, raises the frame with the focussing screen to a suitable distance. The other end of the bellows is drawn over the ocular and clamped by a screw. The framework can also be used for horizontal photomicrography.

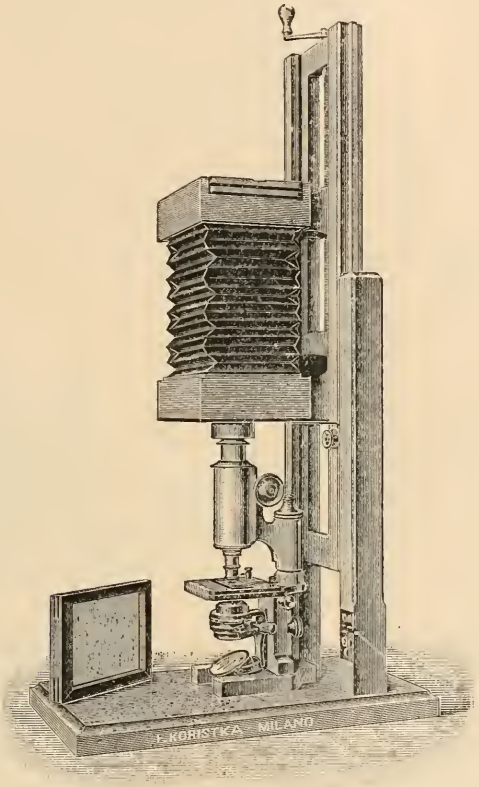



Fig. 66.

**Apparatus for Photographing with Light incident from above and below.†**—F. W. Müller has contrived some changes in the well-known Zeiss apparatus, in order to be able to photograph the upper and under sides of a solid or transparent object. The general arrangements are shown in figs. 69 and 70, the former being for upper side and the latter for under side photography. On the rectangular table which

* F. Koristka's Catalogue, Milan, fig. 64, p. 76.
† Zeitschr. f. wiss. Mikr., xix. (1902) pp. 44–56 (7 figs.).

carries the optical bench is placed the stand, with the object-stage accurately adjusted in a horizontal position. The object can now be

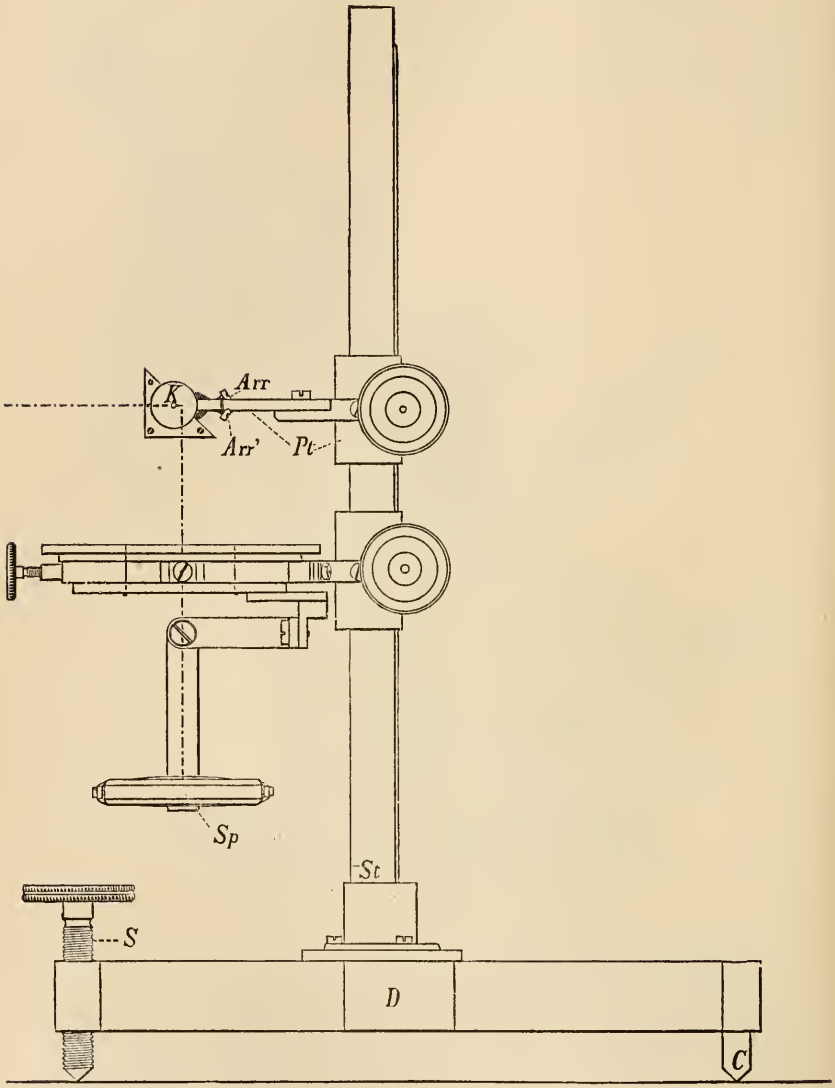



Fig. 67.

illuminated from all sides. A right-angled prism, whose reflecting planes are at exactly 45°, is placed, as required, over or under the object.

The bellows and their stand, which are independent of the preceding, are pushed up to the prism, thus giving a coarse adjustment. On this movable bellows the author has set the objective-tube ; this is regulated by rack-and-pinion and thus a fine adjustment obtained.

The stand (fig. 67) possesses a heavy tripod base, the rear foot C of which is rigid, the two front ones S being levelling screws. The pillar is a triangular guide-bar *St* bearing an obliquely-toothed rack on its rear side and centimetre graduations on one of the front sides. At the upper end the bar is simply truncated. The object-stage and prism-holder are easily lifted off the bar over its upper end, both being secured to sleeves worked up and down by pinions engaging with the rackwork. The stage is rotary and can be clamped by screws ; it is made of blackened brass and must be pierced by a large aperture to allow of the maximum amount of light being con-

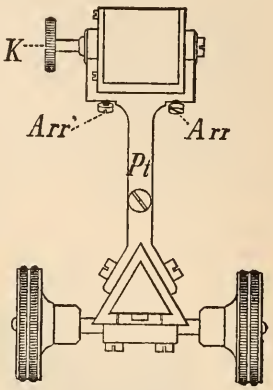



Fig. 68.

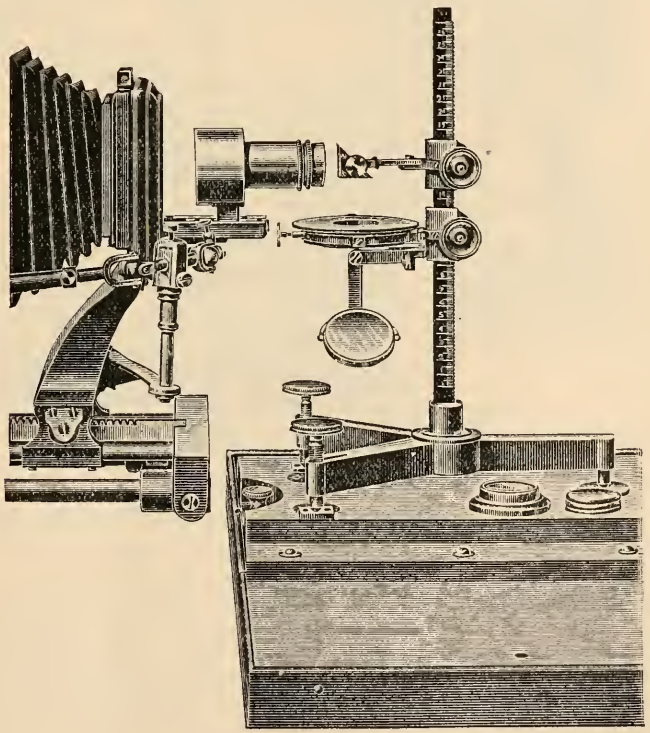


Fig. 69.

centrated from below. A stage of mirror glass with a broad rim cemented on shell-wise can be advantageously used. The illuminating mirror *Sp* can be used on the stage or below it. The prism-carrier *Pt* can be clamped on the guide-bar and must be set in the optic axis : it terminates in a fork, at whose ends are the bearings for the rotation axis of the prism. The size of the prism depends on that of the front lens of the largest objective used. The hypotenuse plane is silvered to improve the reflection. The prism is set in a metal mounting, and its rotation about its horizontal axis is controlled by the milled head K (fig. 68)

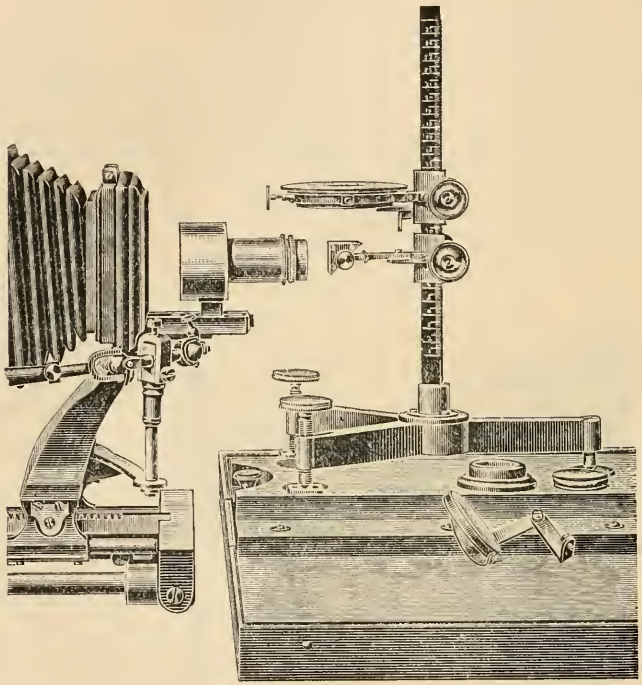


Fig. 70.

and limited by the two stop-screws *Arr*. When the prism has been accurately set, as in fig. 69, with the reflecting plane at 45° to the horizon, by aid of one of the stop-screws, rotation to the other stop turns it through 90° and puts it in the position of fig. 70. The tripod stand is so placed that its feet rest in three prepared spots and is adjusted by means of the two levelling screws. The magnification is estimated in the usual way by means of a magnified glass scale. When the upper surface has been photographed, the stage-holder and prism-holder are unclamped, lifted off, and replaced in reversed order : the prism is rotated through 90° and the under side photographed. For the

luminant, the author uses a nickelled iron reflector with incandescent burner and condenser lenses, whose light he uses direct for downward photography, but employs a hollow mirror for upward work. In order to avoid the inconvenience which may arise from halation, the author puts his plates into the dark slide with their glass side towards the objective.

(5) Microscopical Optics and Manipulation.

**Engelmann's Microspectralphotometer with Grating Spectrum.***—H. Siedentopf describes how the Thorp collodion grating has been adapted by Messrs. Zeiss to Engelmann's instrument.

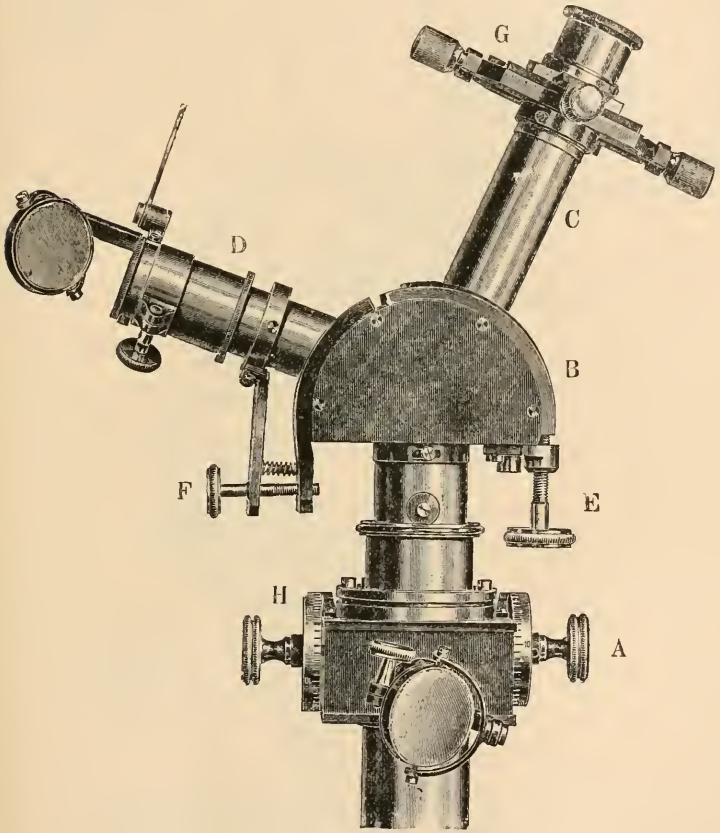



Fig. 71.

Fig. 71 shows the photometer two-thirds of its natural size. On the frame containing the slit the upper part is secured by the clamp-

* S.B. k. preuss. Akad. Wiss. zu Berlin, xxxi. ii. iii. (1902) pp. 706–10 (3 figs.).

screw H. This upper part consists of a flat semicylindrical box B, and is accurately adjusted to the observation telescope C and scale-tube D. The box contains the Thorp transparent grating. The telescope can by

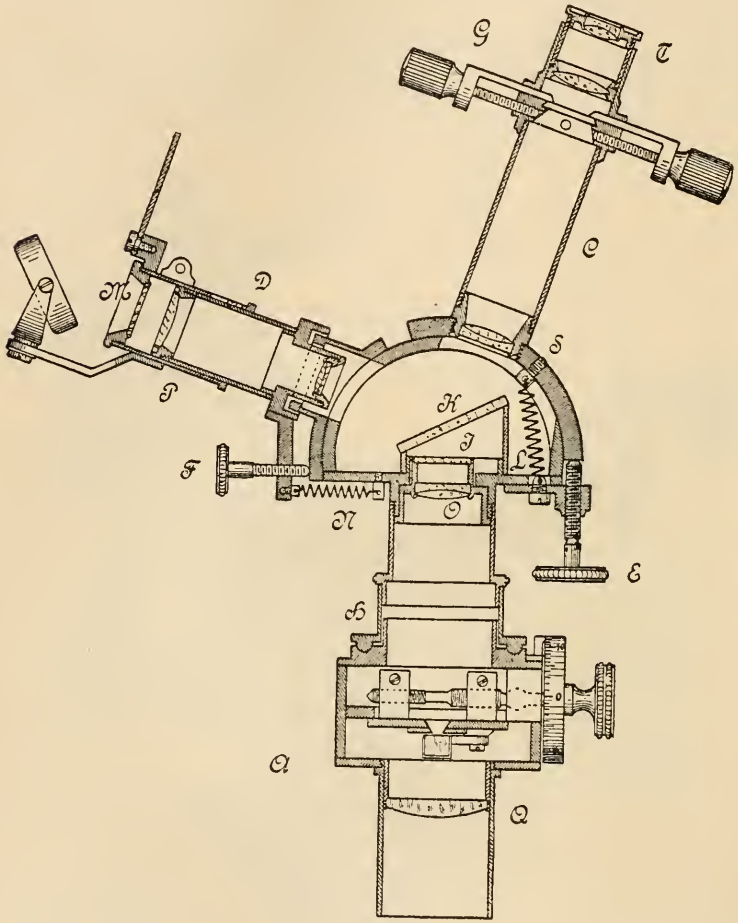


Fig. 72.

rotation of the screw E be brought over the spectrum. The four slides G on the telescope ocular serve for the delimitation of a small rectangular field for photometric comparison. The scale-tube can be accurately applied to the spectrum by means of the screw F.

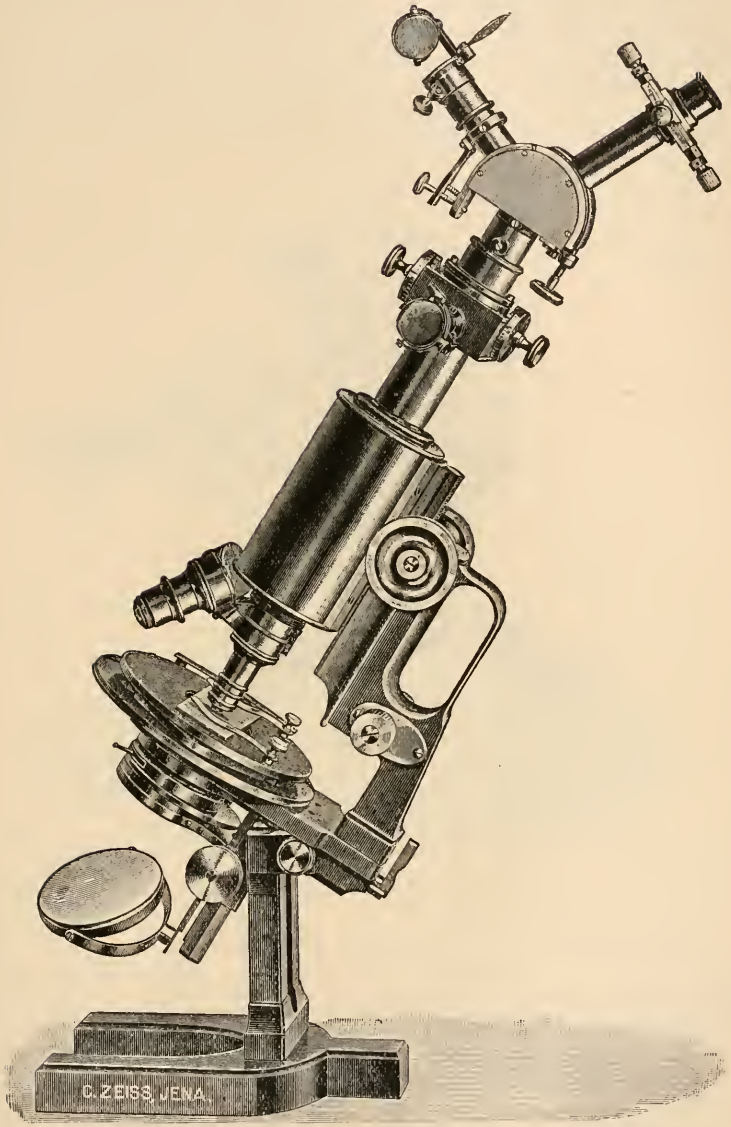



Fig. 73.

Fig. 72 gives a section through the apparatus. Over the grating J an obliquely-set small glass plate with parallel plane sides is placed, serving both for protection of the grating as well as for the reflection of the scale image. The screw E operates against the spring L, and F against the spring N. M is the rotatory wave-length scale, which the sleeve P pushes into the front focal plane of the projection ocular. The lens Q acts as the collective glass of a Huyghens ocular. The achromatic collimator objective O has a free diameter of 11 mm. and a focal

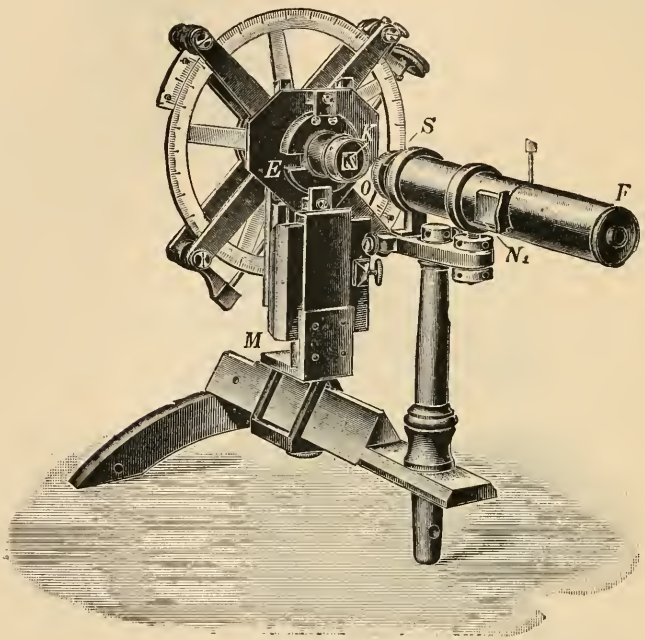



Fig. 74.

length of 50 mm. The telescope objective S is similar. The telescope ocular T magnifies about 15 times the real diffraction spectrum transmitted through the telescope objective S.

Fig. 73 shows the entire apparatus ready for use as applied to Zeiss' No. 1$^c$ stand.

**Koenigsberger's Microphotometer for the Measurement of Light-Absorption.***—In the construction of this instrument J. Koenigsberger

* Zeitschr. f. Instrumentenk., xxi. (1901) pp. 129-33 (2 figs.).

has arranged a diaphragm with two rectangular openings, of 3 by 5 mm. cross section, at a distance apart of 1 mm. Above this diaphragm is a calcspar rhomb 24 mm. high, whose plane-parallel faces make an angle of 55° with the optic axis. The transmitted rays of light undergo double refraction, and therefore form four images in the Microscope. Since the two slits are near together, both the central images partly overlap. In the real image made by the telescope objective this position is stopped out, so that the rest of the light is screened off. In this position also the image of the one slit due to the ordinary ray coincides with the image of the other slit due to the extraordinary ray; and the illumination then consists of equal parts of polarised light, if the two openings have received equal illumination. If an absorbing substance be placed before the one opening, then the intensity of the light falling

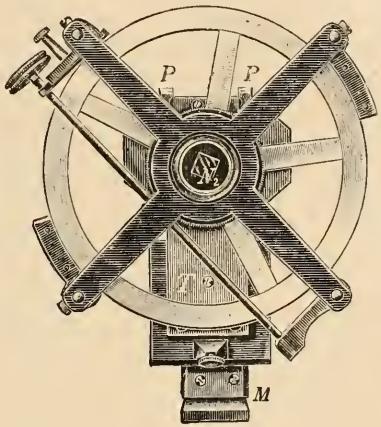



Fig. 75.

on it naturally becomes weaker than that incident on the other; and in consequence the portion of light polarised in the one direction exceeds that polarised in the other. This effect is recognisable by the occurrence of certain interference effects which are wanting in unpolarised light. The light from the other slit is now weakened in the usual manner, either by the insertion of a smoked glass wedge or by the rotation of a nicol, applied under the opening, on a divided circle whose vernier reads to minutes. This weakening is continued until both portions of polarised light again become equal and the interference effects disappear. It is, therefore, clearly on these interference effects that the adaptability of the instrument depends. In homogeneous light this interference brings out with great distinctness the bright and dark bands of a Savart's plate, and for this purpose a small telescope F (fig. 74), adjusted for infinite distance, of sevenfold magnifying power, is used. Between this telescope and the vart's plate S a nicol $N_1$ is

inserted in the Microscope-tube. This nicol need not be rotatory as it keeps its place unchanged, and needs be once for all orientated within 1° to 3°, until the bands attain their maximum sharpness. The Savart's plate is inserted over the Microscope objective O, either in the objective itself or in a specially rotary ring, and must be set with hard wax in such an orientation that the bands appear in the middle of the field. An achromatic lens of 6–9 cm. focus is used as the Microscope objective. The calcspar parallelopiped K of 3·0 cm. long and 1·3 by 1·3 cm. cross section, with plane-parallel faces, is fastened in a tube which is screwed on to a round brass plate of 6 mm. in thickness. At the lower end of the tube the diaphragm with the two slits is applied. In the brass plate there is a rather long incision E for the insertion and withdrawal of the smoked-glass wedge. The brass plate is fastened on to a larger plate by means of two clamps; and when these are tightened up the calcspar and slits can be pushed about until they are in the centre of the field. Under the larger plate two grooved bars P (fig. 75) are attached for receiving a frame with the substance to be examined and brought before one of the openings. On the brass foot M there is a holder T for bearing the divided circle, reading to 5′ and carrying a Thompson or a Leppich nicol. The axis of the Microscope can be made perpendicular, within $\frac{1}{6}°$, to the calcspar crystal planes, either by sloping the Microscope-tube or by adjusting the crystal itself. Observations with the wedge are recommended as the most rapid. The wedge is 7·1 cm. long and has a thickness tapering from 0·35 to 0·1 cm., and on the side of its metal mount is a millimetre scale. Full instructions are given for gauging the wedge for making observations. The light-source was usually homogeneous; but sometimes, as in case of crystals, it is required to take measurements along the whole spectrum; and then a spectral apparatus similar to Wülfing's was employed, and a good Welsbach or acetylene light used.

The author,* however, found that a considerable loss of light resulted from the use of the spectrum apparatus, and he has therefore replaced it by an arrangement which resembles an ocular spectroscope without a second slit. Between the analyser and telescope-tube he places a tube with a small upright prism, whose end-planes are inclined at about 45° to the microscopic axis. A second tube is set perpendicularly to the side of the first and contains a lens (focal length 3 cm.) and a glass scale, the scale being at the focus, so that scale and spectrum are seen together. He found that the brightness was then so great that, even with a small incandescent light, he could measure from $\lambda = 0·690$ to $\lambda = 0·430$.

### (6) Miscellaneous.

**Comparison of British and Metrical Measures at the same Temperature.** Computed from the coefficient given in the Report of the Standards Commission, 1871–2, by E. M. Nelson.

* Op. cit., xxii. (1902) pp. 88–9.

| | in. |
|---|---|
| 1 | ·000039 |
| 2 | ·000079 |
| 3 | ·000118 |
| 4 | ·000158 |
| 5 | ·000197 |
| 6 | ·000236 |
| 7 | ·000276 |
| 8 | ·000315 |
| 9 | ·000354 |
| 10 | ·000394 |
| 11 | ·000433 |
| 12 | ·000473 |
| 13 | ·000512 |
| 14 | ·000551 |
| 15 | ·000591 |
| 16 | ·000630 |
| 17 | ·000669 |
| 18 | ·000709 |
| 19 | ·000748 |
| 20 | ·000788 |
| 21 | ·000827 |
| 22 | ·000866 |
| 23 | ·000906 |
| 24 | ·000945 |
| 25 | ·000985 |
| 26 | ·001024 |
| 27 | ·001063 |
| 28 | ·001103 |
| 29 | ·001142 |
| 30 | ·001181 |
| 31 | ·001221 |
| 32 | ·001260 |
| 33 | ·001300 |
| 34 | ·001339 |
| 35 | ·001378 |
| 36 | ·001418 |
| 37 | ·001457 |
| 38 | ·001497 |
| 39 | ·001536 |
| 40 | ·001575 |
| 41 | ·001615 |
| 42 | ·001654 |
| 43 | ·001693 |
| 44 | ·001733 |
| 45 | ·001772 |
| 46 | ·001812 |
| 47 | ·001851 |
| 48 | ·001890 |
| 49 | ·001930 |
| 50 | ·001969 |
| 60 | ·002363 |
| 70 | ·002757 |
| 80 | ·003151 |
| 90 | ·003544 |
| 100 | ·003938 |
| 200 | ·007876 |
| 300 | ·011815 |
| 400 | ·015753 |
| 500 | ·019691 |
| 600 | ·023629 |
| 700 | ·027567 |
| 800 | ·031506 |
| 900 | ·035444 |
| 1000 | ·039382 |

| mm. | in. |
|---|---|
| 1 | ·039382 |
| 2 | ·078764 |
| 3 | ·118146 |
| 4 | ·157528 |
| 5 | ·196910 |
| 6 | ·236292 |
| 7 | ·275674 |
| 8 | ·315056 |
| 9 | ·354438 |
| 10 | ·393820 |
| 11 | ·433202 |
| 12 | ·472584 |
| 13 | ·511966 |
| 14 | ·551348 |
| 15 | ·590730 |
| 16 | ·630112 |
| 17 | ·669495 |
| 18 | ·708877 |
| 19 | ·748259 |
| 20 | ·787641 |
| 21 | ·827023 |
| 22 | ·866405 |
| 23 | ·905787 |
| 24 | ·945169 |
| 25 | ·984551 |
| 26 | 1·023933 |
| 27 | 1·063315 |
| 28 | 1·102697 |
| 29 | 1·142079 |
| 30 | 1·181461 |
| 31 | 1·220843 |
| 32 | 1·260225 |
| 33 | 1·299607 |
| 34 | 1·338989 |
| 35 | 1·378371 |
| 36 | 1·417753 |
| 37 | 1·457135 |
| 38 | 1·496517 |
| 39 | 1·535899 |
| 40 | 1·575281 |
| 41 | 1·614663 |
| 42 | 1·654045 |
| 43 | 1·693427 |
| 44 | 1·732809 |
| 45 | 1·772191 |
| 46 | 1·811573 |
| 47 | 1·850955 |
| 48 | 1·890337 |
| 49 | 1·929719 |
| 50 | 1·969101 |
| 51 | 2·008484 |
| 52 | 2·047866 |
| 53 | 2·087248 |
| 54 | 2·126630 |
| 55 | 2·166012 |

| mm. | in. |
|---|---|
| 56 | 2·205394 |
| 57 | 2·244776 |
| 58 | 2·284158 |
| 59 | 2·323540 |
| 60 | 2·362922 |
| 61 | 2·402304 |
| 62 | 2·441686 |
| 63 | 2·481068 |
| 64 | 2·520450 |
| 65 | 2·559832 |
| 66 | 2·599214 |
| 67 | 2·638596 |
| 68 | 2·677978 |
| 69 | 2·717360 |
| 70 | 2·756742 |
| 71 | 2·796124 |
| 72 | 2·835506 |
| 73 | 2·874888 |
| 74 | 2·914270 |
| 75 | 2·953652 |
| 76 | 2·993034 |
| 77 | 3·032416 |
| 78 | 3·071798 |
| 79 | 3·111180 |
| 80 | 3·150562 |
| 81 | 3·189944 |
| 82 | 3·229326 |
| 83 | 3·268708 |
| 84 | 3·308091 |
| 85 | 3·347473 |
| 86 | 3·386855 |
| 87 | 3·426237 |
| 88 | 3·465619 |
| 89 | 3·505001 |
| 90 | 3·544383 |
| 91 | 3·583765 |
| 92 | 3·623147 |
| 93 | 3·662529 |
| 94 | 3·701911 |
| 95 | 3·741293 |
| 96 | 3·780675 |
| 97 | 3·820057 |
| 98 | 3·859439 |
| 99 | 3·898821 |

| dm. | in. |
|---|---|
| 1 | 3·938203 |
| 2 | 7·876406 |
| 3 | 11·814609 |
| 4 | 15·752812 |
| 5 | 19·691015 |
| 6 | 23·629218 |
| 7 | 27·567421 |
| 8 | 31·505624 |
| 9 | 35·443827 |

1 metre = 39·38203 in.
= 3·281836 ft.
= 1·093945 yd.

| in. | mm. |
|---|---|
| 1 | 25·392292 |
| 2 | 50·784584 |
| 3 | 76·176876 |
| 4 | 101·569168 |
| 5 | 126·961460 |
| 6 | 152·353752 |
| 7 | 177·746044 |
| 8 | 203·138336 |
| 9 | 228·530628 |
| 10 | 253·922920 |
| 11 | 279·315212 |
| 1 ft. | 304·707504 |
| 1 yd. | 914·122512 |

| in. | mm. |
|---|---|
| $\frac{1}{2}$ | 12·696146 |
| $\frac{1}{3}$ | 8·464097 |
| $\frac{2}{3}$ | 16·928194 |
| $\frac{1}{4}$ | 6·348073 |
| $\frac{3}{4}$ | 19·044219 |
| $\frac{1}{5}$ | 5·078458 |
| $\frac{2}{5}$ | 10·156917 |
| $\frac{3}{5}$ | 15·235375 |
| $\frac{4}{5}$ | 20·313834 |
| $\frac{1}{6}$ | 4·232049 |
| $\frac{5}{6}$ | 21·160243 |
| $\frac{1}{7}$ | 3·627470 |
| $\frac{1}{8}$ | 3·174036 |
| $\frac{3}{8}$ | 9·522109 |
| $\frac{5}{8}$ | 15·870182 |
| $\frac{7}{8}$ | 22·218255 |
| $\frac{1}{9}$ | 2·821366 |
| $\frac{1}{10}$ | 2·539229 |
| $\frac{3}{10}$ | 7·617688 |
| $\frac{7}{10}$ | 17·774604 |
| $\frac{9}{10}$ | 22·853063 |
| $\frac{1}{11}$ | 2·308390 |
| $\frac{1}{12}$ | 2·116024 |
| $\frac{5}{12}$ | 10·580122 |
| $\frac{7}{12}$ | 14·812170 |
| $\frac{11}{12}$ | 23·276267 |
| $\frac{1}{13}$ | 1·953253 |
| $\frac{1}{14}$ | 1·813735 |
| $\frac{1}{15}$ | 1·692819 |
| $\frac{1}{16}$ | 1·587018 |
| $\frac{3}{16}$ | 4·761055 |
| $\frac{5}{16}$ | 7·935091 |
| $\frac{7}{16}$ | 11·109127 |
| $\frac{9}{16}$ | 14·283164 |
| $\frac{11}{16}$ | 17·457200 |
| $\frac{13}{16}$ | 20·631237 |
| $\frac{15}{16}$ | 23·805274 |
| $\frac{1}{17}$ | 1·493664 |
| $\frac{1}{18}$ | 1·410683 |
| $\frac{1}{19}$ | 1·336436 |

| in. | mm. |
|---|---|
| $\frac{1}{20}$ | 1·269615 |
| $\frac{1}{21}$ | 1·209157 |
| $\frac{1}{22}$ | 1·154195 |
| $\frac{1}{23}$ | 1·104013 |
| $\frac{1}{24}$ | 1·058012 |
| $\frac{1}{25}$ | 1·015692 |
| $\frac{1}{30}$ | ·846410 |
| $\frac{1}{35}$ | ·725494 |
| $\frac{1}{40}$ | ·634807 |
| $\frac{1}{45}$ | ·564273 |
| $\frac{1}{50}$ | ·507846 |
| $\frac{1}{55}$ | ·461678 |
| $\frac{1}{60}$ | ·423205 |
| $\frac{1}{65}$ | ·390651 |
| $\frac{1}{70}$ | ·362747 |
| $\frac{1}{75}$ | ·338564 |
| $\frac{1}{80}$ | ·317404 |
| $\frac{1}{85}$ | ·298733 |
| $\frac{1}{90}$ | ·282137 |
| $\frac{1}{95}$ | ·267287 |
| $\frac{1}{100}$ | ·253923 |
| $\frac{1}{150}$ | ·169282 |
| $\frac{1}{200}$ | ·126961 |
| $\frac{1}{250}$ | ·101569 |
| $\frac{1}{300}$ | ·084641 |
| $\frac{1}{350}$ | ·072549 |
| $\frac{1}{400}$ | ·063481 |
| $\frac{1}{450}$ | ·056427 |
| $\frac{1}{500}$ | ·050785 |
| $\frac{1}{550}$ | ·046168 |
| $\frac{1}{600}$ | ·042320 |
| $\frac{1}{650}$ | ·039065 |
| $\frac{1}{700}$ | ·036275 |
| $\frac{1}{750}$ | ·033856 |
| $\frac{1}{800}$ | ·031740 |
| $\frac{1}{850}$ | ·029873 |
| $\frac{1}{900}$ | ·028214 |
| $\frac{1}{950}$ | ·026729 |

| in. | $\mu$ |
|---|---|
| $\frac{1}{1000}$ | 25·392292 |
| $\frac{1}{2000}$ | 12·696146 |
| $\frac{1}{3000}$ | 8·464097 |
| $\frac{1}{4000}$ | 6·348073 |
| $\frac{1}{5000}$ | 5·078458 |
| $\frac{1}{6000}$ | 4·232049 |
| $\frac{1}{7000}$ | 3·627470 |
| $\frac{1}{8000}$ | 3·174036 |
| $\frac{1}{9000}$ | 2·821366 |
| $\frac{1}{10000}$ | 2·539229 |
| $\frac{1}{15000}$ | 1·692819 |
| $\frac{1}{20000}$ | 1·269615 |
| $\frac{1}{25000}$ | 1·015692 |

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Anaerobic Plate Cultures.**†—H. S. Fremlin describes a simple apparatus for anaerobic plate cultures. It consists of a circular glass chamber 5 in. in diameter and 1 in. in depth—sufficiently large to take the ordinary 11 cm. Petri dish—provided with a wide carefully ground rim. The lid of the chamber is flat and ground at the periphery where it comes into contact with the rim of the chamber. The ground surfaces which come into contact are well smeared with vaseline to secure perfect sealing of the chamber. The inoculated plate resting in the lid of the second Petri dish is placed in the chamber, and pyrogallic acid and caustic soda solutions are then introduced, as is done in preparing a Buchner's tube anaerobic culture, and the lid secured in position. Chemical and bacteriological tests prove the efficiency of the apparatus.

**Ring Test for Indol.**‡—S. B. Grubbs and E. Francis, in utilising the acid nitroso-indol reaction, suggest the employment of the test under certain standard conditions, viz. applying the test to cultivations in fluid media containing 1 p.c. peptone, and grown for 24 hours at 37° C., in the following manner. About 8 to 10 drops of pure concentrated sulphuric acid are added to 7 c.cm. of the cultivation in a test-tube and the mixture well shaken. Three or four cubic centimetres of a 1 in 1000 sodium nitrite solution are carefully run down the side of the tube so as to form a layer on the surface of the mixture of culture and acid. In the presence of indol a pink ring at the junction of the two fluids should show up sharply and distinctly within a period of one hour—the time limit allowed for contact.

**Differentiation of True and False Diphtheria Bacilli.**§—J. Bronstein and E. N. Grünblatt, relying on the fact that the Klebs-Loeffler bacillus produces acid quite early in the course of its growth whilst the pseudo-diphtheria bacillus produces alkali, propose to differentiate these two organisms by testing cultivations with Mankowski's reagent. This reagent is prepared by adding a mixture of 2 parts of a 2 p.c. watery solution of indigo-carmin and 1 part of a 10 p.c. solution of acid fuchsin in 1 per cent. caustic soda solution to 22 parts of distilled water. The reagent gives a ruby red colour in the presence of acid, and green in that of alkali. Cultures are made in pepton-broth with half per cent. glucose (titrated at incubation temperature with Mankowski's reagent as the indicator and rendered exactly neutral), and are incubated at the body temperature for twenty-four hours, together with uninoculated control tubes. At the end of this time about 3 drops of Mankowski's reagent are added to each tube with the result that the

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Lancet, 1903, i. p. 518.

‡ Bull. 7, Hygienic Lab. U.S. Marine Hospital Service, 1902.

§ Centralbl. Bakt., 1te Abt. Orig., xxxii. (1902) pp. 425–8.

sterile broth is blue, the broth in the tube containing the Klebs-Loeffler bacillus at once assumes a ruby red colour, and that in the tube containing the pseudo-diphtheria bacillus after a few minutes becomes green. After twelve hours' further incubation, however, this last will also give a red colour.

**Differentiation of B. coli and B. typhosus.***—R. Zielleczkey, in differentiating *B. coli* from *B. typhosus*, employs the following medium in place of Petruschky's "Lakmusmolke": ordinary nutrient broth, in which has been dissolved 1 p.c. agar with the addition of 0·1 to 0·5 of a solution of phenolphthalein to every 5 ccm. of medium. The phenolphthalein solution is prepared by dissolving 0·5 gram phenolphthalein in a mixture of 50 c.cm. absolute alcohol and 50 c.cm. distilled water, and then diluting the fresh solution to twenty times its volume with distilled water. In this medium the *B. coli* produces a colour change in from 5 to 8 or 9 hours, whilst the *B. typhosus* does not produce any change until after about 15 hours.

**Anaerobic Cultivations.†**—D. Rivas claims to have simplified anaerobic methods of cultivation by the use of media containing sulphindigotate of soda and freshly prepared solution of ammonium sulphide. The author makes his fresh ammonium sulphide solution in a similar manner to that suggested by Hammerl,‡ and adds it in the proportion of 5 p.c. to feebly alkaline broth, gelatin, or agar containing 1·5 p.c. pepton and 1 p.c. glucose. Two cubic centimetres of a 10 p.c. solution of sulphindigotate of soda in sterile distilled water are then added to the medium per litre. Another medium employed in his experiments was prepared in a similar manner to the above, but 50 c.cm. of a 1 p.c. solution of sodium sulphide was substituted for the ammonium sulphide. This, however, did not give quite as good results.

Glass test-tubes, each provided with a constriction at the junction of its middle and lower thirds, somewhat similar to Roux's potato culture tubes, were employed in Rivas' experiments. After filling the medium into the tubes almost to the level of the constrictions and sterilising, the medium was inoculated and the upper surface of the inoculated medium covered with a layer of sterile oil to prevent access of oxygen to the culture. The author by these means was able to obtain good cultivations of the bacilli of tetanus and of malignant œdema and other obligate anaerobes.

**Differentiation of B. typhosus and B. coli.§**—Mabel P. Fitzgerald and G. Dreyer contribute a paper of extreme importance in which they describe the results of their experiments to elucidate the character of the so-called coli-reaction observed when the *B. coli* is grown in media coloured with neutral-red. They find the reaction is a quantitative and not a qualitative one, which can be obtained with Grubler's neutral-red and to a less extent or not at all with other commercial brands. Glucose-free bouillon tinted with neutral-red is a preferable medium to agar; whilst media having an acid reaction corresponding to more than 0·5 p.c.

* Centralbl. Bakt., 1te Abt. Orig., xxxi. (1902) pp. 752–68.
† Op. cit., xxxii. (1902) pp. 831–42. ‡ See this Journal, 1902, p. 370.
§ Festskrift Statens Serum Inst. Copenhagen, 1902.

$H_2SO_4$ (phenolphthalein being used as the indicator) retard or even prevent the colour change; further, that under certain cultural conditions *B. typhosus* can produce colour reactions similar to those regarded as peculiar to the *B. coli*. The authors finally propose as a means of differentiating the *B. typhosus* from the *B. coli*, the use of a bouillon containing 3 or 4 p.c. lactose and coloured by the addition of 0·5 p.c. of a 1 p.c. watery solution of neutral red (Grubler). The reaction of this medium does not reqnire to be accurately standardised, although a reaction corresponding to 1 p.c. $H_2SO_4$ appears to give the best results. In such a medium the *B. typhosus* produces a yellow colour within 4 to 6 days, whilst the *B. coli* produces a red coloration, and no further change takes place even after the lapse of considerable periods.

**Enrichment Method for Typhoid Bacilli.***—The method described by E. Altschüler depends on the specific agglutination reaction. The first step is to incubate the suspected water at 37° for 24 hours in a medium containing 1 p.c. peptone and 0·5 p.c. common salt. Then 10 c.cm. are pipetted into a burette, the lower end of which is fitted with a piece of rubber tubing and a clip. To the 10 c.cm is then added immunised serum, and after about 7 hours the precipitate is passed into another tube which contains pepton-salt solution and a few sand-grains. This second tube, half the size of the former, is fitted at both ends with a piece of rubber tubing and a clamp. After an incubation of 24 hours it will be found that the typhoid germs have much increased in number.

### (2) Preparing Objects.

**Ether as a Narcotising Medium for Aquatic Animals.**†—Hjalmar Östergren advocates the virtues of ether-water for narcotising marine or fresh-water animals. By means of vigorous shaking in a tightly corked bottle, 2 parts of ether to 25 of water (sea or fresh) an almost saturated solution of ether (7–8 p.c.) is obtained. This solution can of course be diluted to any desired extent, and as each kind of animal differs as to its susceptibility for ether it is advisable to begin with low strengths and work up to higher grades. Certain animals should be previously treated with magnesium sulphate or chloride by Tullberg's method.‡ Others which are not influenced by the magnesium salts may be treated with good result by the following device. The animals are placed in a tall vessel containing their natural water. The strong ether mixture is then poured carefully over the surface and the two layers are gradually mixed by stirring the fluids together at longer or shorter intervals. If necessary more strong ether solution may be added or even 95 p.c. alcohol.

Of course the narcotising operations should be carried out in closed vessels.

**Demonstrating the Structure of Gastropods.**§ — G. Mazzarelli places the living larvæ in a test-tube containing some sea water and then

* Centralbl. Bakt., 1te Abt. Orig. xxxiii. (1903) pp. 741–3 (1 fig.).
† Zeitschr. wiss. Mikr., xix. (1903) pp. 300–8.
‡ See this Journal, 1892, p. 435.
§ Rend. R. Istit. Lombardo, xxxv. (1902) pp. 719–20.

adds a few drops of 2 p.c. cocain solution. In an hour or so the animals are sufficiently anæsthetised to be studied under the Microscope. It is necessary to put a thin piece of glass or metal between the cover-slip and slide to prevent the animals from being crushed.

If it be desired to fix the larvæ the best results will be obtained from the use of Rabl's, Eisig's or Mingazzini's fluids. The formula for the last is 2 parts of saturated aqueous solution of sublimate and 1 part of absolute alcohol with the addition of 5 p.c. of glacial acetic acid. Acetic-sublimate (5 p.c. aqueous sublimate with 5 p.c. acetic acid) acts equally well. In these fluids the larvæ may be left several, even 24 hours.

If the preparations turn brown by the action of osmic acid they need not be stained but may at once be dehydrated and then passed through cedar oil (24 hours) to xylol and afterwards mounted in Grubler's neutral balsam.

For staining the preparations both *in toto* or in sections hæmalum, carmalum, hæmacalcium, Ehrlich's hæmatoxylin, and safranin were used. If they were to be stained on the slide the sections 5–10 $\mu$ thick were stuck on with water, but if already stained they were stuck with steam or by Schällibaum's method.

#### (3) Cutting, including Imbedding and Microtomes.

**Fixing and Imbedding Dense Connective Tissue.***—E. Retterer thus formulates the results of his experience :—Avoid too long immersion in alcohol, and too much heat when pieces are impregnated with paraffin. The procedure which he has found invariably to be successful is as follows. The skin is fixed in Flemming's, Zenker's or Branca's fluid, washed in water and then dehydrated in alcohol (90° for 1 hour and absolute for ½ hour). It is then transferred to xylol (20 minutes), and next to a mixture of xylol and paraffin at 36° (30 minutes at 20°). The object is then placed in a test-tube containing paraffin (melting-point 36°) at 40° and submitted to the action of a water pump so as to remove the air. After a quarter of an hour *in vacuo* the tissue is imbedded in paraffin at 54°. Too great heat is avoided by impregnating with liquid paraffin melted off a solid block placed in a test-tube. This step takes about 10 minutes.

**New Methods of Paraffin Imbedding.**†—V. Pranter finds that ligroin and carbon tetrachloride are very suitable solvent agents for paraffin. Ligroin, which is obtained by fractional distillation of American raw petroleum, dissolves more paraffin (melting-point 54°) at room temperature than chloroform. Carbon tetrachloride dissolves more paraffin than ligroin or chloroform, but less than carbon sulphide ; it is, however, not poisonous or inflammable like the latter. The objects, which have been fixed in alcohol, are placed in thin cedar oil for 12 hours, after which they are transferred to fresh oil for another 12 hours, by which time they are quite transparent.

The pieces are next placed in ligroin or carbon tetrachloride for at

* Journ. Anat. et Phys., xxxix. (1903) p. 196.
† Zeitschr. wiss. Mikr., xix. (1903) pp. 329-32.

least 12 hours, then for another 12 hours in a saturated solution of paraffin in ligroin or tetrachloride. These preceding stages are carried out at room temperature. The pieces are now placed in a thermostat at 58° for about half an hour, and then transferred to liquid paraffin (melting-point 54°–56°). The last step is repeated, and then after about 3 to not more than 6 hours the preparations are imbedded in paraffin (melting-point 54°–56°). The blocks obtained by this method allow very satisfactory sections to be cut from them, and crumpling is slighter and less frequent than by the ordinary imbedding methods.

**Carbon tetrachloride as a Clearing Fluid.***—J. Plečnik points to the inflammability of carbon bisulphide as a great objection to its use as the clearing medium for tissues that are to be imbedded in paraffin, and also mentions the fact that it causes disintegration of nuclei stained with osmium.

The author tried petroleum-ether for the purpose, but found that though better in some respects, it was equally inflammable and did not yield such easily cutting tissues as carbon bisulphide. He therefore advocates the employment of carbon tetrachloride as the clearing medium in such cases, as it is not open to either of the objections urged against carbon bisulphide, nor does it interfere with the easy cutting of thin sections from the imbedded tissues, though the results are not quite so satisfactory as with carbon bisulphide.

### (4) Staining and Injecting.

**Differential Stain of B. Diphtheriæ.†** — J. W. Peck suggests the substitution of Loeffler's (alkaline) methylen-blue for the acetic acid methylen-blue usually employed in Neisser's differential method. The author states that it is more reliable in swabbings and in cultures, shows the differential staining equally well in recent and in old cultivations, and, moreover, has the advantage of never staining either the bacillus of Hoffmann or the *B. coryzæ segmentosus*.

**Flagella Staining.‡** — G. de Rossi cleans the cover-glasses with alcohol, then puts them for 10 to 15 minutes in boiling sulphuric acid, washes repeatedly in water, immerses in a mixture of equal parts of alcohol and benzin, wipes them with a clean cloth, and finally flames them 40 to 50 times over a Bunsen burner. The films should be made from agar cultures 8 to 12 hours old at 37°, or 18 hours old at 15° to 20°. Before using a culture it should be examined in a hanging-drop in order to ascertain if the bacteria are sufficiently motile. If so, then a particle from the culture is removed by means of a platinum loop, and mixed with a droplet of water on a slide. From the emulsion a loopful is removed to a watch-glass, in which has been placed some 10 to 15 drops of distilled water. After stirring the emulsion and the water up together a little drop is removed on a loop and placed on the centre of a cover-glass. It is not spread out, but is allowed to dry in the air or in an exsiccator. The films are not fixed. For the staining three solutions are required :—(A) consists of 50 grm. pure carbolic

* Zeitschr. wiss. Mikr., xix. (1903) pp. 328-9. † Lancet, 1903, i. p. 92.
‡ Centralbl. Bakt., 1te Abt. Orig., xxxiii. (1903) pp. 572-6.

acid, 40 grm. of tannic acid, and 1000 grm. of water; (B) of 2·5 grm. basic fuchsin, and absolute alcohol 100 c.cm.; (C) of potassium hydrate 1 grm., and distilled water 100 grm. Solutions A and B are mixed together and kept in a tightly corked bottle. When required for staining, solution C is added drop by drop to the A B mixture until a dusty looking precipitate can be seen at the margin. The fluid is then filtered and 4 or 5 drops of the clear filtrate poured over the prepared film. The staining fluid becomes, after a variable time, iridescent, then turbid, and finally deposits a precipitate. When this last stage occurs the flagella are stained. The preparation is then washed with distilled water and dried with blotting-paper.

**Demonstrating Trypanosomata.***—M. Elmassian and E. Migone, when studying the "Mal de Caderas," a disease of South American Equidæ, used the following solutions:—(A) Hæmatein 0·5 gr., ammonia alum 5 grm., water 100 c.cm. (B) Magenta red 1 grm., absolute alcohol 10 c.cm., water 100 c.cm. The Trypanosoma blood was spread on slides and fixed first in absolute alcohol for 12 hours, and then in 5 p.c. bichromate of potash for 1 to 3 hours. The films having been carefully washed in tap water, were stained for a quarter of an hour or more in a mixture of the two solutions (5 c.cm. of the first and a drop of the second). Sometimes it was found better to use the staining separately and successively instead of simultaneously. In this way a better hæmatein effect is attained without overstaining with magenta. The addition of 20 to 30 grm. p.c. to the hæmatein solutions was often an improvement. Stained in this way the nucleus of Trypanosoma is violet, the flagellum dark red, the protoplasm dull red, and the membrane bright red. This method also demonstrates the presence towards the blunt end of a spherical body (micronucleus, centrosome) which is of variable size and is invariably connected with the flagellum or filament.

**New Glass Staining-Trough.**†—J. Schaffer describes a glass trough which he has found useful for staining series of sections on slides of the English or Vienna shape. The measurements are 9 by 8 by 5 cm. The trough is provided with a lid and will accommodate 10 (or 20 placed back to back) slides in the long direction and 12 (or 24) in the short. Except in shape and adaptability to two kinds of slides this apparatus does not differ materially from many other staining troughs.

**Method for Staining Bacterial Granules.**‡—M. Ficker advises the use of a solution composed of methylen-blue (med. pur. Höchst) and lactic acid 2 p.c., for staining bacterial granules. A suspension of bacteria in tap-water is placed on a slide and a drop of the solution is run under the cover-glass in the usual way. This may be repeated several times, with an interval of some minutes between the turns.

**Staining and Preservation of Serial Sections on Paper Strips.**§ A. Schoenemann describes the following procedure which he adopts for

* Ann. Inst. Pasteur, xvii. (1903) pp. 243-4 (1 pl.).
† Zeitschr. wiss. Mikr., xix. (1903) pp. 297-300 (1 fig.).
‡ Hyg. Rundschau, xii. (1902) p. 1131.
§ Zeitschr. wiss. Mikr., xix. (1903) pp. 336-6.

staining and mounting serial sections. The sections are stuck on strips of non-colourable paper, the ordinary celloidin sections being taken out of 90 p.c. alcohol, while the paraffin and dry celloidin sections are treated as they are. After the strips have been allowed to dry in the air for a quarter of an hour, they are placed in xylol or in a mixture of equal parts of chloroform and 90 p.c. alcohol. After having been mopped up with filter-paper the strips are immersed in 90 p.c. alcohol. After being pressed again between folds of filter-paper the strips are put in distilled water, and from this to dilute hæmatoxylin solution (hæmalum, Delafield's, &c.). After a thorough washing the strips are transferred to eosin-alcohol (90 to 95 p.c. alcohol) from which they are passed through carbolxylol to xylol. The strips may be kept in xylol, paraffin oil, or in cedar oil.

**Method for Demonstrating Cartilaginous Micro-Skeletons.***—J. W. van Wijhe makes permanent preparations for demonstrating the cartilaginous skeleton of embryos by the following method. The embryo is fixed in 5 p.c. sublimate solution, or 10 p.c. formol, or in Zenker's fluid, and is preserved in alcohol. Before staining, the object is immersed for a day or two previously in acid-alcohol (½ p.c. HCl) and this must be renewed if it has turned yellow next day. After the acid-alcohol bath, the object is placed for a day, or better for a week, in an alcoholic solution of methylen-blue to which 1 p.c. hydrochloric acid has been added. The blue-stained object is then immersed in acid-alcohol, renewed several times on the first day and once daily afterwards. The renewal is continued until the alcohol shows no blue tinge the next day.

In about a week the stain has been removed from all the tissues, except from the fundamental substance of the cartilage. The object is then dehydrated in absolute alcohol and clarified in xylol. This last procedure is done gradually in order to prevent wrinkling: the first stage being 2 parts alcohol to 1 of xylol; the second, 1 part alcohol to 2 of xylol; and the third, pure xylol. After this the objects are put first in a thin, afterwards in a thick solution of balsam in xylol, and finally in a solution which at ordinary temperature is solid, but liquid at 60°. In this solution they are kept in a thermostat at 60° for a couple of hours, and are then enclosed in glass cells under a cover-glass. The ordinary glass cells are usually too low, but higher ones are easily made by fixing strips of window-glass on a slide with balsam.

**Method for Staining Sputum for Bacteriological Examination.**†—W. H. Smith describes the following method. Solutions needed :—anilin-oil-gentian violet, Gram's iodine, saturated aqueous solution of eosin, Loeffler's alkaline methylen-blue, mixture of 95 p.c. alcohol 4 parts and ether 6 parts, 95 p.c. alcohol, absolute alcohol, xylol.

The films should be made from fresh sputum to which neither carbolic acid nor corrosive sublimate has been added. The film is fixed in the flame in the usual way. Then drop on some gentian-violet and heat till it vaporises; wash off I.K.I.; put on more I.K.I. and heat;

* K. Akad. Wetensch. Amsterdam, Proc. Sect. Sci., v.(1902) pp. 47–51.
† Boston Med. Surg. Journ., cxlvii. (1902) pp. 659–62.

decolorise with 95 p.c. alcohol; wash in the alcohol-ether mixture, wash with water, stain for a few minutes with eosin, wash off excess with Loeffler's solution. Drop on more methylen-blue solution and heat; decolorise with 95 p.c. alcohol, wash in absolute alcohol, treat with xylol, and mount in balsam.

### (5) Mounting, including Slides, Preservative Fluids, &c.

STRASSER, H.—**Die Nachbehandlung der Serienschnitte auf Papier-unterlagen.** (The after-treatment of serial sections on paper-underlays.)
*Zeitschr. wiss. Mikr.*, XIX. (1903) pp. 337-45.

### (6) Miscellaneous.

**Encyclopædia of Microscopical Technique.***—The recent issue of the *Encyclopædia of Microscopical Technique* is an event of great importance in the world of microscopical literature. The work appears in two volumes comprising together some 1400 octavo pages, and whilst appealing primarily to the medical microscopist contains much that is interesting and valuable as well as instructive to the technical student and also to the amateur. The Encyclopædia is devoted solely and entirely to descriptions of apparatus and methods, and the articles, numbering several thousands, vary considerably in length—many extending to thirty, fifty, or even more pages—and form masterly treatises in their respective subjects. Many articles are signed, and wherever the importance of the subject demands such additions, a fairly complete bibliography is appended. The printing and paper are good; the subject headings being printed in larger and blacker type render it an easy matter to find any desired article.

Illustrations are scattered through the pages to the number of about 130 in the two volumes. These form perhaps the only disappointing feature of the Encyclopædia, consisting for the most part of woodcuts of apparatus and diagrams culled from the catalogues of various microscopical instrument makers. Within the pages of this Encyclopædia are to be found minute details of all the various methods of microscopical research, in all its various branches, histology, pathology, zoology, botany, bacteriology, &c., some of the most important being those on fixation by von Tellyesniczky, injection by Prof. Hoyer, paraffin and paraffin imbedding by Neumayer, serial sections (celloidin) by Helbing, photomicrography by Zoth. The various stains and chemical reagents employed in microscopical work, such as corrosive sublimate, osmic acid, iodine, chromic acid and its salts, are also carefully described and their special applications fully discussed.

Embryology is well catered for, two papers in particular, Embryological Technique and Methods of Experimental Embryology, by Prof. Ballowitz and Dr. Wetzel respectively, being worthy of careful perusal.

Special methods of staining too are very fully and carefully treated,

* 'Encyklopädie der Mikroskopischen Technik mit besonderer Berücksichtigung der Färbelehre, herausgegeben von P. Ehrlich, M. Mosse, R. Krause, H. Rosin und C. Weigert,' Berlin and Vienna, 1903, 2 vols., 1400 pp., with illustrations.

notably, silver methods by Dr. Mosse, gold methods by Prof. Szymonowicz, Golgi's method and its modifications by Prof. Kallius.

The methods applicable to various special tissues such as the sense-organs, and especially the nervous system, are very fully described. From even the few articles we have indicated it will be seen that the work under notice is a veritable storehouse of exact information, and forms an invaluable adjunct to the laboratory equipment of the working microscopist; and we feel certain that as such it will be warmly welcomed and heartily appreciated.

**Eyre's Bacteriological Technique.***—It is difficult to praise too highly J. W. H. Eyre's *Elements of Bacteriological Technique*. Though it claims only to be a laboratory guide for the medical, dental, and technical student, it is much more than this, and no doubt its practical usefulness will be appreciated by many superintendents of bacteriological and clinical laboratories. The author describes with unusual clearness the apparatus, methods, media, &c. required for the detection and demonstration of microbes in the living and the dead, and in earth, air, and water. These descriptions are aided by numerous illustrations, nearly all of which have been prepared specially for this volume, and about which the author cogently remarks that a good picture possesses a higher educational value and conveys a more accurate impression than a page of print. Besides technique there are chapters dealing with the morphology of the Hyphomycetes and Blastomycetes, and with the anatomy, physiology, and biochemistry of the Schizomycetes; while another section gives the outlines for the study of pathogenic bacteria. There is no doubt that this work will appeal strongly to medical and dental students, but it ought also to technical students generally, for it contains all the laboratory information and instructions requisite for brewing, dairying, and agriculture. Though the limits of our space prevent us from doing justice to this eminently practical guide, we may express the conviction that it will be highly appreciated and extremely successful.

Kraus, R.—**Ueber eine neue regulierbare Vorrichtung für den heizbaren Objekttisch.** (An apparatus for keeping the water on the hot stage at a constant temperature.) *Centralbl. Bakt.*, 1te Abt. Orig., XXXII. (1902) pp. 467–9 (1 fig.).

„ „ **Ueber einen Apparat zur bakteriologischen Wasserentnahme.** (An apparatus for obtaining water for bacteriological examination.) *Tom. cit.*, pp. 469–71 (2 figs.).

## Metallography, &c.

**Microscopic Appearances of Volcanic Dust.**†—T. Andrews, in a lecture given at the University of Cambridge, demonstrated the magnetic properties of volcanic dust and the effect of polarised light thereon. The author also described the appearance of the volcanic dust ejected from Mont Soufrière, St. Vincent Island. This dust consisted of minute particles of varying size, the majority being more or less transparent. The largest grains seemed mostly to consist of volcanic glass, in which gas was frequently occluded in internal cavities. The medium-sized

* W. B. Saunders & Co., Philadelphia and London, 1902, 371 pp., 170 figs.

† Engineering, lxxv. (1903) pp. 195–9.

particles appeared also to consist of volcanic glass together with felspar crystals, while the small-sized dust was mostly mineral crystals or their disintegrated fragments. Some of the larger particles appeared to be of the nature of a greenish volcanic glass; there were also crystals or fractured portions of crystals apparently of felspar and quartz. A noticeable feature was the presence of some partially transparent particles of greenish-brown tint which seemed to indicate the presence of olivine, and sometimes brown coloured semitransparent glassy particles were noticed. Many of the transparent crystals manifested a sharpness on their edges, but others were more or less rounded. When viewed with polarised light, the effect on some of the crystalline particles was very fine. In some of the glassy crystals were noticed numerous internal cavities seemingly enclosing volcanic gases. Some of these particles which did not transmit light appeared to be of the nature of the magnetic oxide of iron. The paper is illustrated by eighteen photomicrographs, thirteen of which give the appearances in the dust from Mont Soufrière, four of the dust from Cotopaxi, and one, that of volcanic iron crystals.

**Analysis of Steel-Works Materials.***—H. Briarley and F. Ibbotson have produced a valuable work on this subject, and have striven to include only those methods of analysis which have been verified and tested by the authors themselves or have been done under their supervision. Parts i.–x. (282 pp.) deal with the chemical aspects of analysis, and part xi. with the Micrographic analysis of steel. This latter section, which will naturally be the most interesting part of the book to microscopists, deals with the following details:—Preliminary preparations, Methods of polishing, Etching the specimens, Heat-tinting, Rapid method of preparation, Mounting, Microscopic accessories, Photography. The final division, treating of the Microstructure of steel, is subdivided into pure iron-carbon steels, manganiferous steels, and steel castings. There are about fifty photomicrographs embracing a great variety of types of steels, and a copious bibliography. Part xii. deals with pyrometry, part xiii. with miscellanea. An appendix with a bibliography of steel-works analysis concludes the work.

**Certain Properties of the Alloys of the Gold-Silver Series.**†—W. C. Roberts-Austen and T. K. Rose have found that it is preferable to use only silver as the alloying metal with gold in the manufacture of trial plates. Such an alloy has accordingly been used at the Royal Mint since the beginning of the present year, instead of fine gold, for checks in the assay of standard bars and coins. In view of the minute accuracy with which the operations of coinage have to be conducted, this is a matter of much importance. By this method any errors are avoided which might be caused by accidental variations in weights occurring after the trial plates have been made.

* Longmans, Green & Co., London, 1902, 501 pp.
† Proc. Roy. Soc., lxxi. (1903) pp. 161–3 (3 figs.).

# MICROSCOPY.

## A. Instruments, Accessories, &c.*

### (1) Stands.

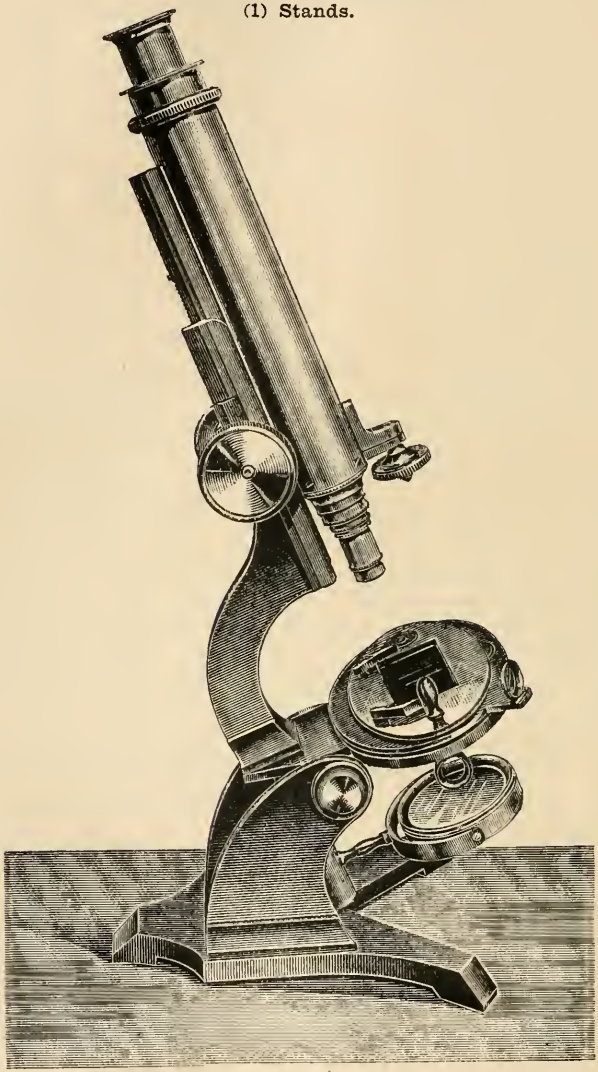


Fig. 121.

**Old Microscope by M. Pillischer.**—Figs. 121 and 122 represent the Microscope made by Michael Pillischer about 1847 for Sir William

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

White-Cooper. This instrument was exhibited by Mr. Jacob Pillischer at the March meeting (see p. 245). Fig. 121 gives a general view of the instrument, and fig. 122 shows the Tomes stage opened out and the method of pivoting the three oval plates. When used as a dissecting Microscope, these plates form convenient tables on which to place specimens and small instruments.

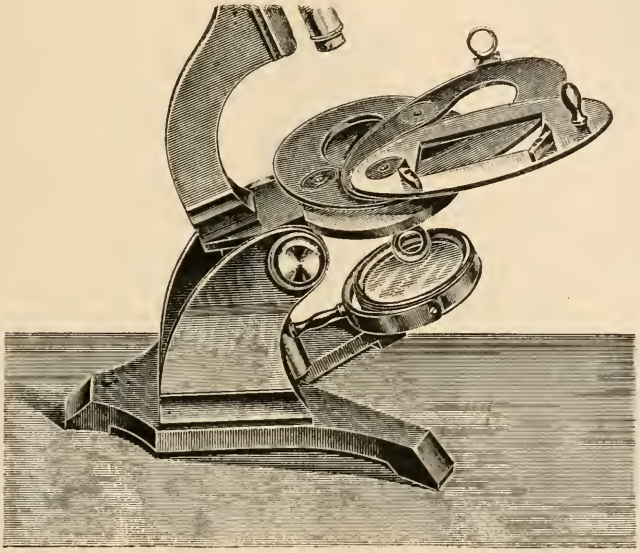


Fig. 122.

**New Portable Microscope.** — This Microscope, figs. 123 and 124, exhibited at the June Meeting by Dr. C. Charlton Briscoe, was made from the design of Prof. Herbert Jackson by Messrs. Swift and Son, who suggested several of the details in its construction. It is specially designed for use at the bedside, and, considering the work it is capable of doing, is of unusually small dimensions.

The body, which can be extended by a draw-tube to 160 mm., slides in a cloth-lined fitting; it has an eye-piece of R.M.S. standard gauge, and the nose-piece takes objectives with the standard screw-thread. The fine adjustment is steady with the highest powers.

The stage, which is one of the chief novelties in this instrument, has $\frac{3}{4}$-in. motion vertically and transversely, the latter motion being in arc.* The substage condenser is achromatic and has an aplanatic aperture of 0·92; the top lens can be removed when using low powers. It is fitted with iris diaphragm and throw-out cell and screws for centring.

* The transverse movement of the stage in arc is not new. A figure of a Microscope, made about 1855-60, having a stage with this movement, is given in the Journ. R.M.S. for 1898, p. 668.

The case, made to hold the instrument with bottles of solutions, blood-counting slide, pipettes, and other items, measures 8 in. by 4 in. by $1\frac{3}{4}$ in., and weighs under 2 lb., but the Microscope can be fitted by itself in a case measuring $6\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $1\frac{3}{10}$ in., and the weight with two objectives would then be under $1\frac{1}{2}$ lb.

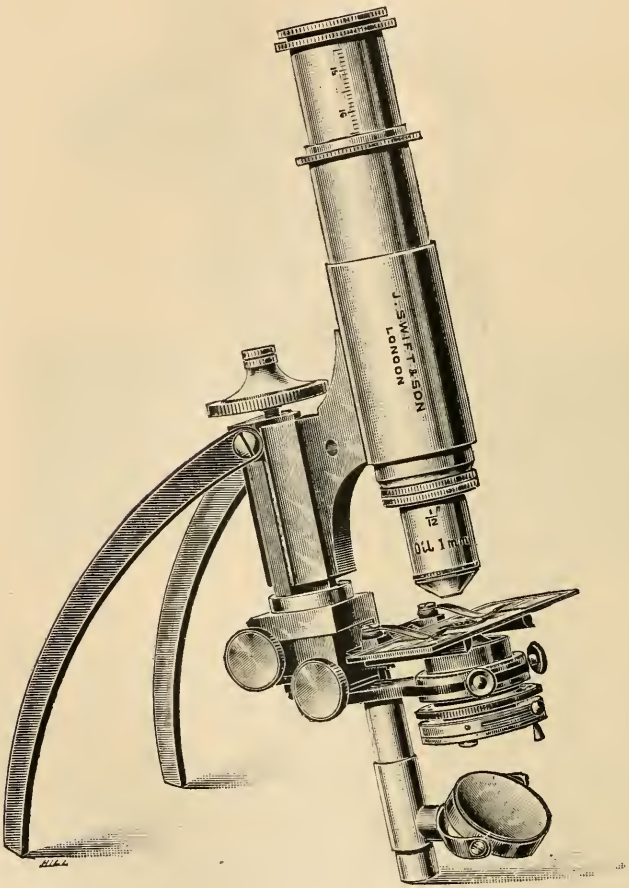



Fig. 123.

**Beck's Portable Continental Model.***—This Microscope, known as Stand No. 1123, is shown in figs. 125 and 126. It has a sliding coarse adjustment, and a delicate micrometer-screw fine adjustment. The stage,

* Messrs. R. and J. Beck's Catalogue, London, p. 18.

with its revolving diaphragm, swings round for facility in packing, and the base is made folding for the same purpose. It is packed in a morocco-covered case, measuring 8 by $2\frac{3}{4}$ by $2\frac{1}{2}$ in.

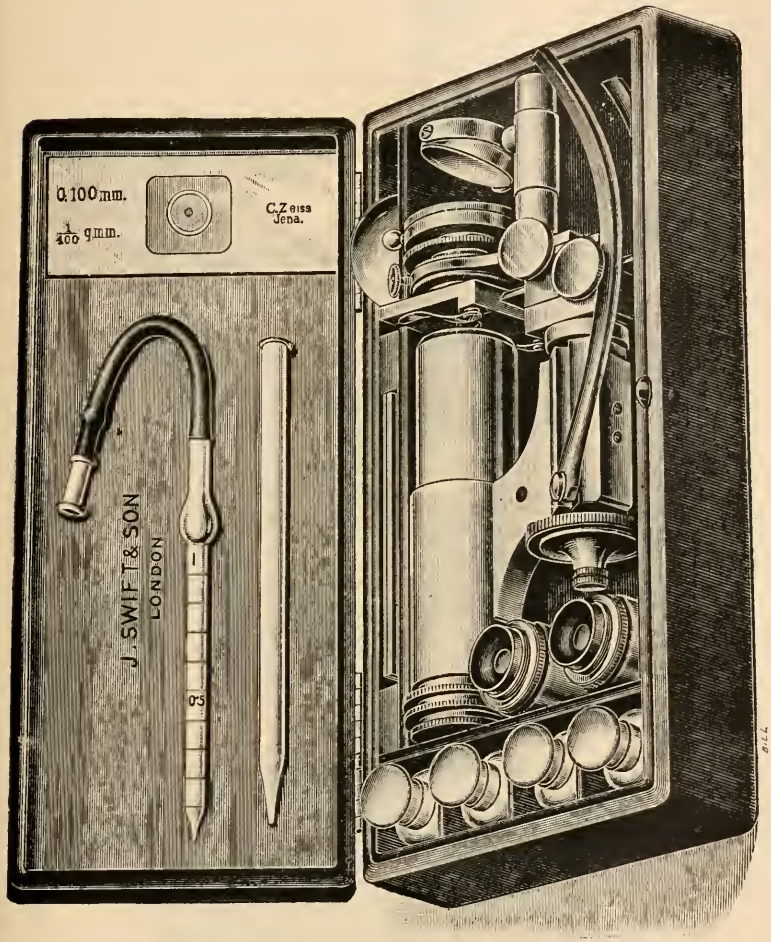



Fig. 124.

**New Double-hinged Limb-holder.*** — Messrs. Leitz have made for M. P. Porsild a double-hinged limb, so that their preparation Microscope may be used for several other purposes. The upper part of the limb (fig. 127) is of the usual character, but is raised and lowered by rack-and-pinion operated by the milled heads shown below the stage. Near

* Zeitschr. f. wiss. Mikr., xix. (1902) pp. 41–4 (2 figs.).

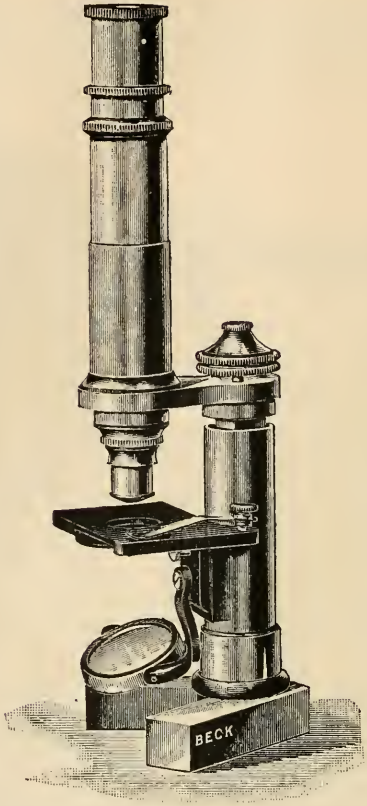



Fig. 125.

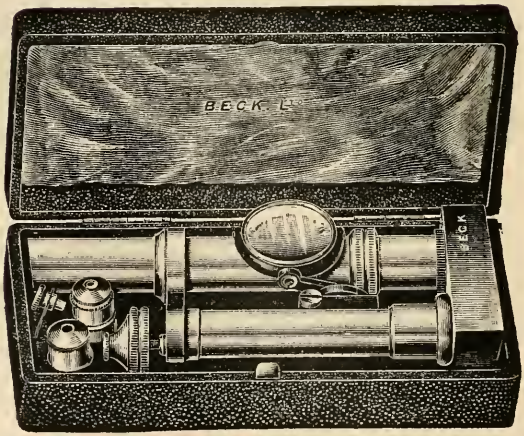



Fig. 126.

the lower end of the limb is a hinge, which permits it to be vertically rotated through 90°, so that the tube-axis can be brought parallel to the stage. In this position the instrument can be used as a cathetometer, or Microscope for reading vertical distances, especially for such subjects as plant-growths which could be estimated by the eye-piece micrometer

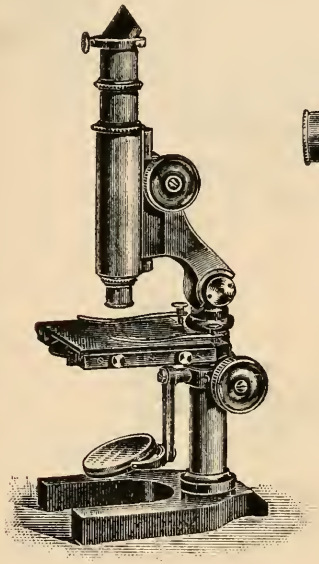


Fig. 127.

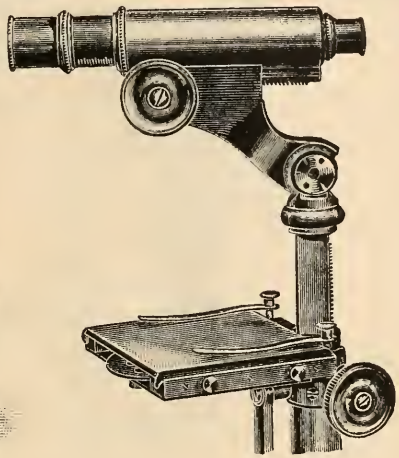


Fig. 128.

measurements. A millimeter scale could be engraved on the triangular bar. Below the stage the pillar has a rotation hinge which enables the optical part to be used with greater freedom (fig. 128).

The instrument can also be conveniently used as an aquarium Microscope, but it would be an improvement to lengthen the lower end of the tube.

Even when the instrument is used as a preparation Microscope the double hinging is useful, as it facilitates search over the field.

**Koristka's Mechanical Stage.***—This accessory is shown in fig. 129. The movements in the two directions are 80 mm. and 40 mm. respectively, and the two divided scales are provided with verniers, which

* F. Koristka's Catalogue, Milan, p. 54.

serve to fix the position of any point of interest. Both screw-heads are placed on the left so as to leave the operator's right entirely free.

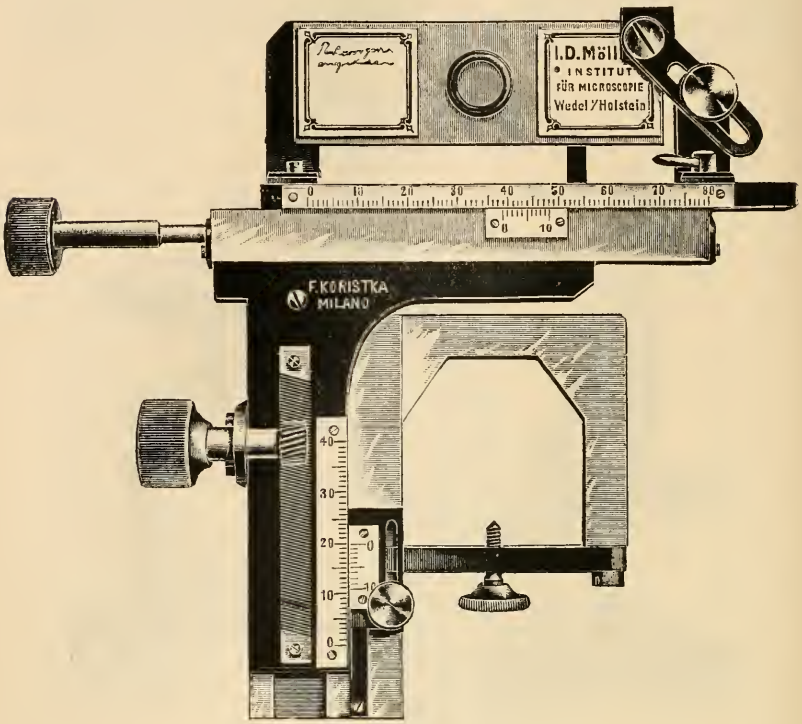



Fig. 129.

**Koristka's Hand Magnifiers.***—The loup shown in fig. 130 has two pairs of two achromatic cemented lenses. The mount of the upper works in a thread so that its distance from the lower pair can be altered. In this way the magnifying power can be varied from 5 to 10 diameters. The field in each case is flat and large.

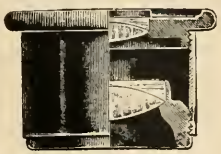


Fig. 130.

* F. Koristka's Catalogue, Milan, fig. 50, p. 64.

(3) Illuminating and other Apparatus.

**New Projection Apparatus for Scientific Work.***—L. B. Elliott, in designing this instrument, has adopted the fundamental principle of a fixed optical centre for all parts of the apparatus, the only adjustment required being that to bring the source of light into the optical axis and to separate it the proper distance from the first element, namely, the rear lens of the condensing system. To this end all the optical parts and their connections are mounted upon vertical pillars attached to heavy steel blocks, which, in turn, are mounted upon a steel bar, rectangular in section, having two inclined surfaces, accurately planed, on

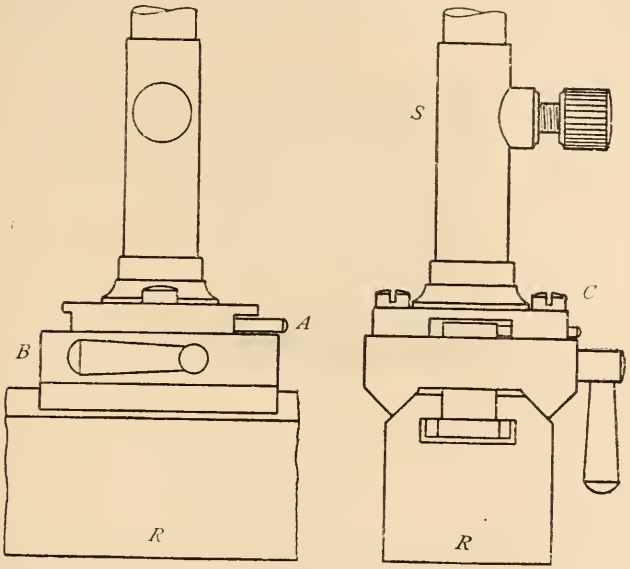



Fig. 131.

its upper side, the whole contrivance resembling a fine lathe-bed in rigidity and accuracy of centring. A T-slot is milled in the upper portion of the rod from one end to the other, and in this a T-piece attached to a vertical axis passing through the block and carrying the optical parts is placed. The T-piece may be rotated through 90° by means of the lever A, fig. 131, placing its long axis parallel with the axis of the T-slot, when the whole block may be lifted off from the bar, or if removed may be replaced upon the bar and held in position by releasing the lever A, which is actuated by a spring, causing the long axis of the T-piece to assume a position at right angles to the axis of the T-slot. This lever, being actuated by a spring, automatically locks

* Journ. App. Micr., vi. (1903) pp. 2136-47 (8 figs.).

the block on the rod, preventing accidental overturning during adjustment. The block with whatever optical apparatus it may carry, now rests upon the two inclined surfaces of the bar, and may be slid along its length, permitting whatever adjustment is required, and when in proper position the lever B is depressed, locking the whole rigidly upon the bar by means of a cam which draws the T-piece firmly against the top of the T-slot. It will thus be seen that any part of the optical equipment can be removed from the apparatus, or replaced, by releasing the T-piece through the operation of the lever B, and rotating the lever A through 90°, and that each element will always return exactly in the optical axis, since its support rests only on the two inclined surfaces of the rod R, and must in every case find the true centre through the clamping action of the cam lever B. The rigidity of the steel bar R and the heavy construction of the base-blocks and vertical supports of the optical part

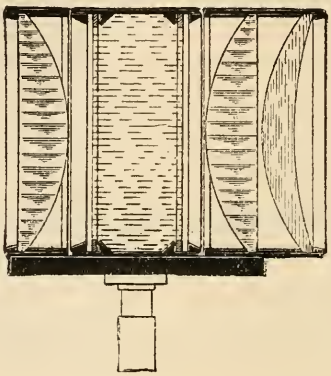


Fig. 132.

retain the alignment and centring. Fig. 131 shows the details of construction of the base-blocks for apparatus supports with the two inclined planes on which the blocks rest. S is the piece in T-slot which, when rotated 90° by the lever A, permits the removal of the base-block from the rod; B is the clamping lever, which clamps the base-block rigidly on the rod R. Fig. 132 is a section of the condenser and water-cell. The condenser is a triple system between the two anterior elements of which the water-cell is placed, securing the maximum absorption of heat rays with the minimum loss of light. The hand-fed electric arc lamp is shown in Fig. 133 and is formed of a vertical and a horizontal carbon, which are therefore at right angles to one another. They can be actuated simultaneously or separately. The placing of the carbons at an angle of 90° to one another with the horizontal carbon in the optical axis not only throws a greater volume of light from the crater of the positive carbon through the condensing lenses, but retains the glowing crater always exactly in the optical axis, no matter how irregularly the two carbons may burn. Fig. 134 shows the whole apparatus complete.

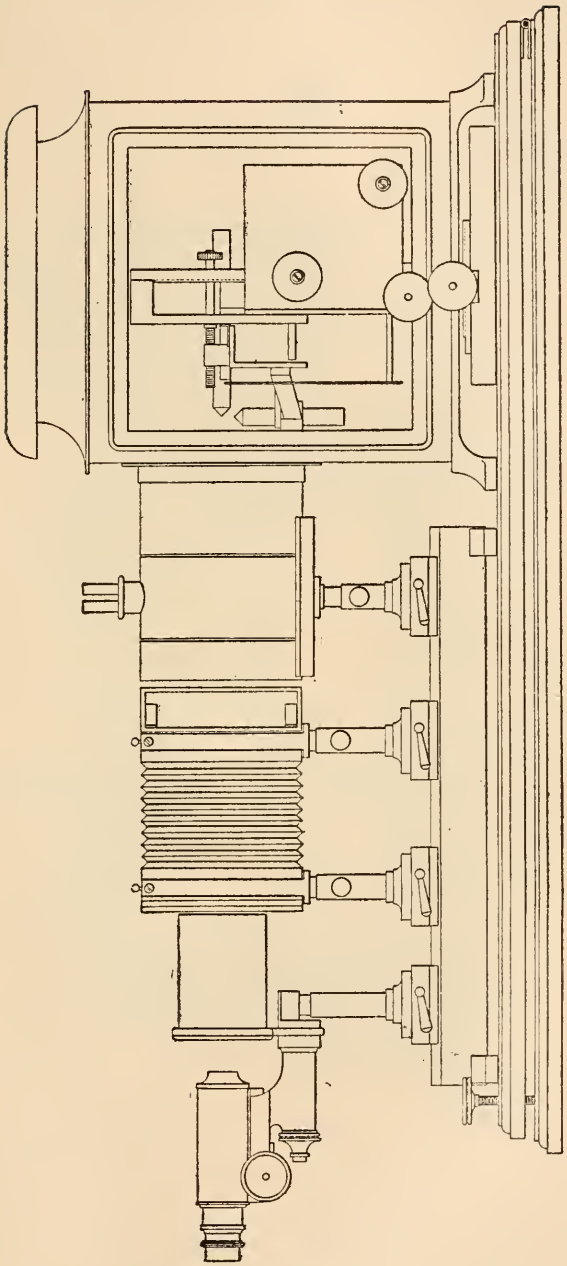


FIG. 133.

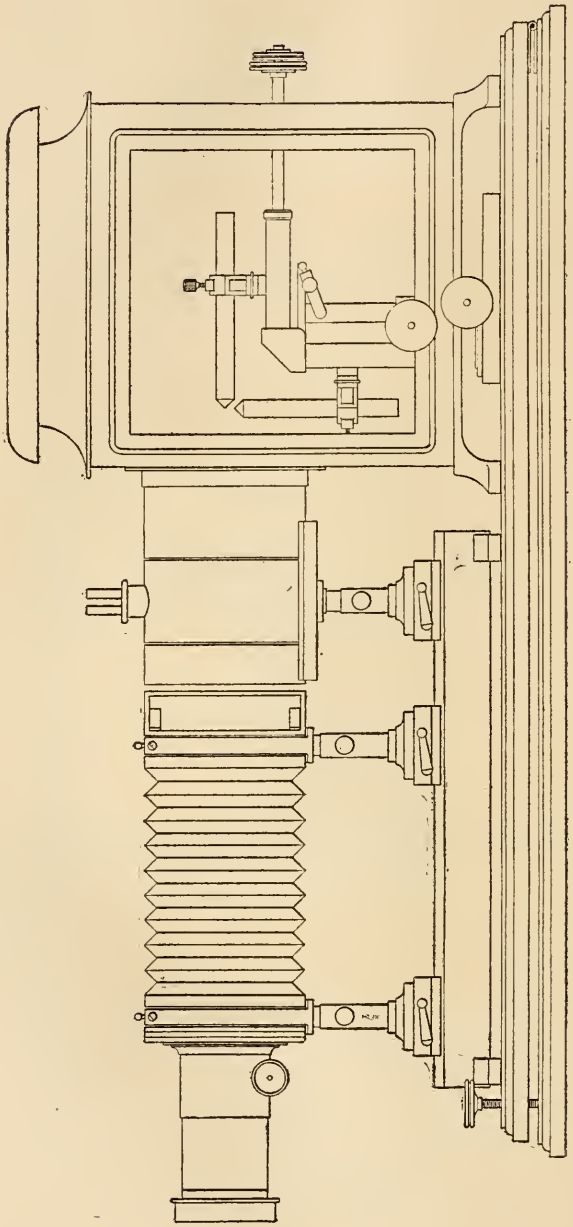


Fig. 134.

**Koristka's Apparatus for the Microscopic Projection of Liquid Preparations.***—This arrangement is shown in fig. 135. The electric

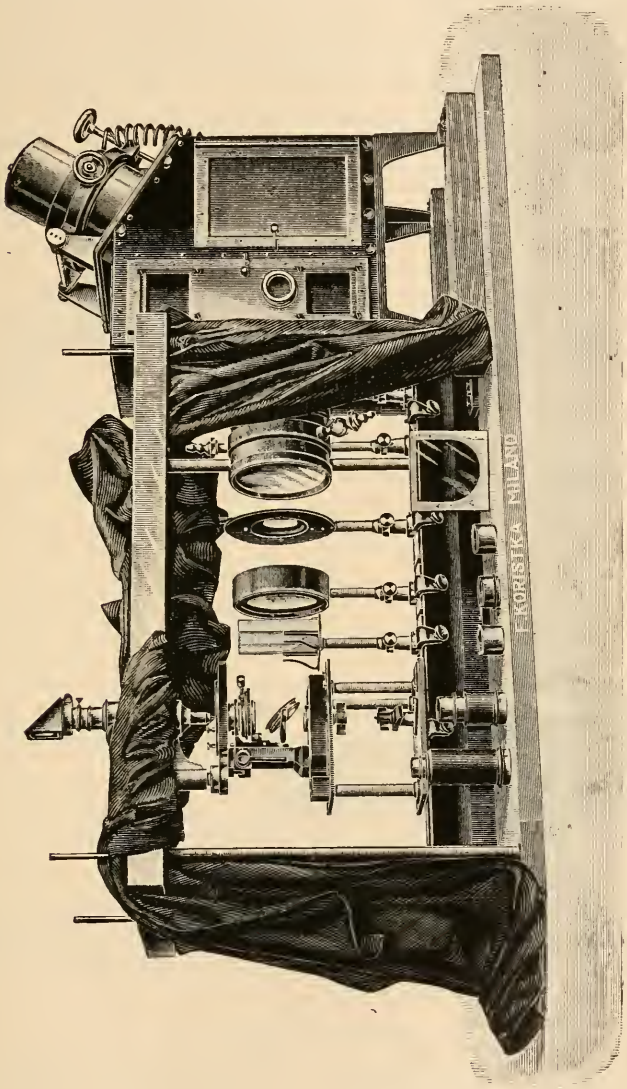



Fig. 135.

rays, after proceeding through the usual diaphragms and condensers, impinge upon the mirror of the Microscope. They are then reflected up

* F. Koristka's Catalogue, Milan, fig. 70, p. 81.

through the tube and are again reflected at the hypotenuse of an isosceles right-angled prism. The emergent rays can then be received on any convenient screen.

**Koristka's Abbe Camera Lucida with Lens-Holder.***—This instrument, shown in fig. 136, while principally designed for low powers, is also adapted for drawing objects their natural size without the aid of a lens. The camera lucida with its large mirror, 90 by 150 mm., and with

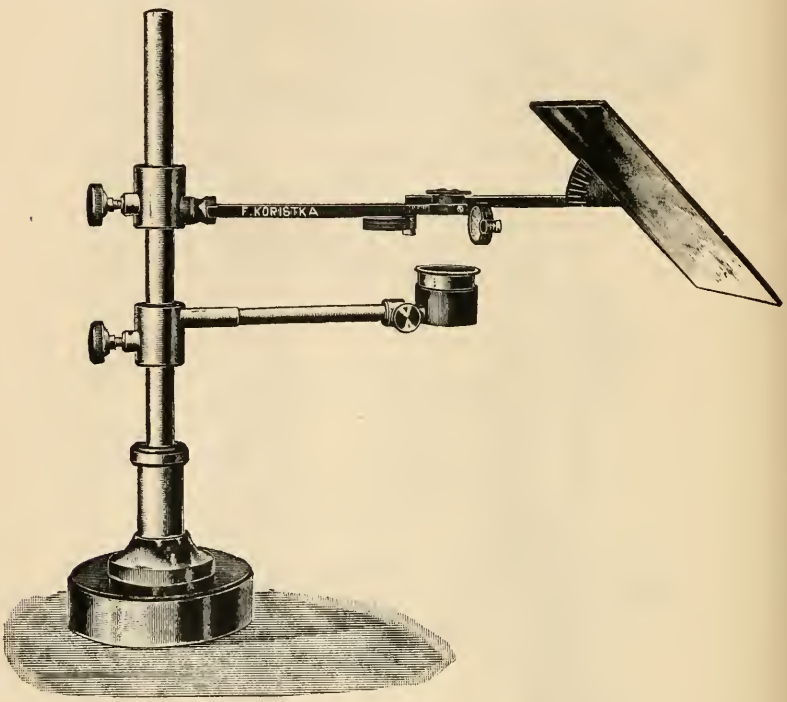



Fig. 136.

gilded double prism, takes a very large field. It is fitted with two series of smoked glasses, one for interposing between the prism and the mirror and the other for insertion between the prism and the magnifying lens.

### (6) Miscellaneous.

**Jena Glass.**†—The nature of the contents of this book place it out of the reach of ordinary criticism. It can scarcely be compared, it

* F. Koristka's Catalogue No. 11, Milan, 1903, fig. 45, p. 63.

† 'Jena Glass and its Scientific and Industrial Applications,' by Dr. H. Hovestadt. Translated and edited by J. D. Everett, M.A., F.R.S., and Alice Everett, M.A. Macmillan & Co., London, 1903, 8vo, xiv. and 419 pp., 29 figs.

stands almost alone. It is a scientific discourse upon an entirely new series of optical metals. It would be well if we had accessible anywhere an equally accurate and efficient account of optical glasses in use before this remarkable and most valuable series of Jena glasses were devised and made accessible.

As a treatise it is a monument to the scientific knowledge, skill, ingenuity, and indomitable resolution of German men of science. The labour must have been great; the book is practically a record of various experiments which have been made to discover the composition needful to obtain a series of optical fluxes which should possess the properties optical and mechanical for securing results that had been before optically impossible. Sir I. Newton had satisfied himself that the hindrance to the production of a perfect optical instrument, such as a telescope, was not the production of perfect figures in the glasses, but the different refrangibility of the rays of light. In the glasses used in the construction of optical instruments prior to the production of the optical fluxes of Jena, two kinds of glass having proportional dispersion powers could not be found; as is well known, "irrationality of spectrum" resulted and absolute chromatic correction could not be accomplished. The want of proportion in the dispersion of the various colours of the spectrum in two kinds of glass, such as were obtainable before the Jena glasses were produced, left a colour or colours outstanding in "corrected" or achromatic combinations of, for example, microscopic object-glasses, known as the *secondary spectrum*.

It is by the production of the most ingenious vitreous compounds of which this book gives careful history and elaborate scientific details, combined with fluor-spar, that this secondary spectrum was removed and a new era for microscopic objectives and work inaugurated; and in every field in which optical instruments are used an immensely important series of improvements have resulted.

Amici showed that the introduction of a drop of water between the first surface of the object-glass and the covering glass of the object would diminish the loss of light which arose from the passage of the rays from the object into air before reaching the objective. Sir David Brewster had seen and suggested this as far back as 1813, and its adoption was known as the "water-immersion." Clearly, however, when the rays enter the object-glass from water instead of air, both its refractive and dispersive action will be altered; and important constructive modification would be needed to suit the new conditions. Hartnack was the first to successfully bring this about, and the immersion system was introduced. This system was still more powerfully to influence the future of the Microscope under the now famous *homogeneous system of immersion*. This system was first suggestively employed by Tolles; but Prof. Abbe had at the same time a more or less clear perception of its potential value. "The matter assumed, however, subsequently, a different shape in consequence of a suggestion made by Mr. John Ware Stephenson . . . of London, who independently discovered the principle of homogeneous immersion." *

* Abbe, this Journal, ii. (1879) p. 257.

The new method consisted in the replacement of the water in the immersion system by cedar oil which is placed between the front surface of the object-glass and the upper surface of the cover-glass of the mounted object. The oil has the same refractive and dispersive power as crown glass, and therefore the correction collar, though a refinement having value still, was no longer inevitable.

The construction of a combination of lenses which would satisfy these conditions was earnestly desired and ultimately urged by Mr. Stephenson upon Prof. Abbe; and eventually the long series of researches and experiments so efficiently detailed in the book we are considering led to the formation of new vitreous compounds making possible the large numerical apertures and almost perfect corrections of an entirely new series of lens-combinations now known as "apochromatic"—opening a new era in Microscopy.

This glass is now so generally used in all high class optical work throughout the world, that a book like this giving authoritatively much that it is of the greatest value to know concerning its construction and its optical and mechanical properties, is a boon to all working opticians, and a service rendered to mathematicians and physicists.

Many pages are given to the consideration of the optical properties of the glasses, and to the manner in which the perfection of optical systems is secured by the utilisation of the special properties of the glasses. Almost equally interesting is the discussion of the mechanical properties of these vitreous combinations, which are carefully recorded and explained.

Much space is devoted to quite another feature which these glasses in a marked degree are distinguished by, which is their endurance and behaviour under varying thermal conditions. One important matter especially to the employment of these compounds for optical lenses and especially for the lenses of Microscopes, is the manner in which lenticular surfaces made of the compounds are susceptible to tarnish and inimical changes when exposed to varying conditions of atmosphere.

From this book it is manifest what great advances can be made by steady purpose in investigation and enterprising experiment. The advancement of practical optics by the devising of these vitreous compounds has been very great, and as a side-issue it is not unimportant that the discovery of the combinations has shifted the centre of the world's optical work from England to Germany. The annual inflow into England alone of optical instruments from Germany represents, relatively, a new item and one of immense financial importance. But it is not to be supposed that all that can be done has been done. May we not hope that the enterprise of English opticians will lead them to make effort, so that what is still attainable in the yet further advancement of the "metals" out of which lenses may be rendered still more efficient, shall if possible be secured?

### B. Technique.*

#### (1) Collecting Objects, including Culture Processes.

**Apparatus for Decanting off Culture Fluids.†** — W. Behrens describes an apparatus constructed by V. Basila which is intended for removing from a stock vessel definite quantities of culture media without fear of contamination.

The apparatus, made entirely of glass, consists of an Erlenmeyer's flask A in connection with which is a spherical vessel D, the latter having a suction-tube C and a discharge pipe B. By means of the taps E and F, D can be shut off above and below. By means of the tap E the communication between D and A and B can not only be cut off but can be made with one or both simultaneously. The tap F is so bored that it allows air to pass either way.

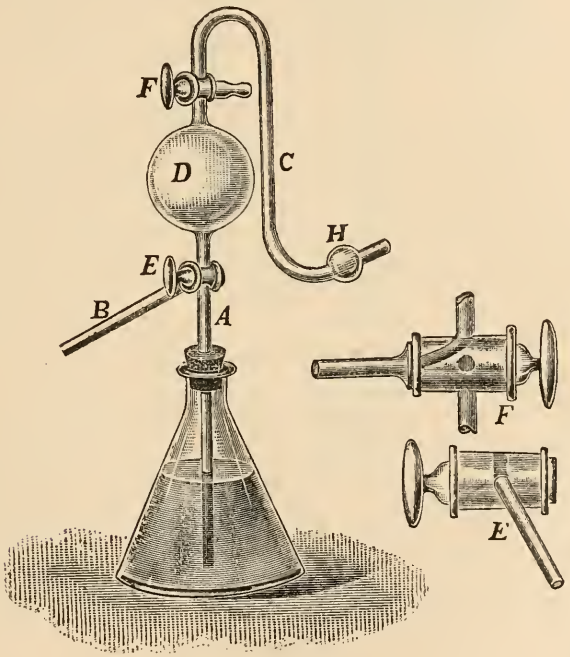



Fig. 137.

When the apparatus is to be used, cotton-wool is stuffed into the bulb H, the flask is filled with culture fluid, and the whole having been steam sterilised the caoutchouc plug is inserted. The tap E is turned

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous. † Zeitschr. wiss. Mikr., xix. (1903) pp. 429–31 (1 fig.).

so as to close A and B. The tap F is now opened so that the interior of D is in communication with the external air, and then by means of a suction pump a vacuum is made in D. By closing F and opening E, some of the culture fluid ascends into D, and then by another turn given to E, any desired quantity can be run off through the tube B.

### (2) Preparing Objects.

**Decalcification Method.*** — As the outcome of an elaborate series of experiments with various reagents under different conditions, J. Schaffer thus formulates his method of decalcification. The piece of tissue must be well fixed and then carefully imbedded in celloidin. Harden the celloidin block in 85 p.c. alcohol, after which remove the alcohol by immersion in water. Then place the block for 12 to 24 hours, or still longer if the piece be large, in 3 to 5 p.c. nitric acid, using a Thoma's water-wheel. From the acid the block is transferred to a 5 p.c. solution of lithium and sodium sulphate. In this it should remain from 12 to 24 hours, the solution being changed at least once. Then wash in running water for 48 hours, after which dehydrate in graded alcohols up to 85 p.c.

**Reagent Bottle.†**—S. E. Dowdy describes a drop-bottle for containing and applying stains and reagents used in histological work. The apparatus consists of a wide-mouthed bottle, a tight-fitting cork, a couple of pieces of glass tubing, a rubber teat, and a piece of rubber tubing to connect up the outlet tube. Its advantages consist in keeping the reagent free from dust, in allowing its removal without taking out a stopper, and in the control over the amount deposited on the slide. Empty bottles may be used for removing excess of liquid from slides and also as a gathering pipette and collecting bottle for pond life.

### (3) Cutting, including Imbedding and Microtomes.

**New Imbedding Medium.‡**—G. Marpmann recommends celluloid dissolved in aceton as an effective substitute for celloidin. Celluloid chips, which are very cheap, are placed in a wide necked bottle and covered with about ten times their bulk of aceton. The bottle, which should be tightly corked, must be frequently shaken at intervals and then allowed to stand until the celluloid is quite dissolved. The clear supernatant fluid is then poured off. Two solutions are required, one thin, the other of a thick syrupy consistence. The material, which must be perfectly dehydrated, is placed in the thin solution for some days and then some of the thick solution is poured in. The medium is inspissated by allowing slow evaporation under a bell-jar.

The blocks, which should be free from cracks or holes, may be kept in 80 p.c. alcohol. The sections may be mounted as they are, or the celluloid may be dissolved out by means of aceton.

**New Freezing Plate for Hand Microtome.§**—B. Solger describes a microtome with a new freezing plate which is to all intents and pur-

* Zeitschr. wiss. Mikr., xix. (1903) pp. 308-28, 441-63.
† Eng. Mech., lxxvii. (1903) p. 169.
‡ Zeitschr. angew. Mikr., ix. (1903) pp. 14-6.
§ Zeitschr. wiss. Mikr., xix. (1903) pp. 294-6.

poses a modification of the Roy model. It consists of a foot-plate about 3 cm. long, attached to a screw clamp which serves to fix the instrument to the bench and supporting a slot for the reception of the nozzle of the ordinary spray apparatus attached to its upper surface. The foot-plate supports the freezing-plate (5 cm. by 2 to 2·5 cm.) by means of a short upright (about 2 cm.) The under surface of the

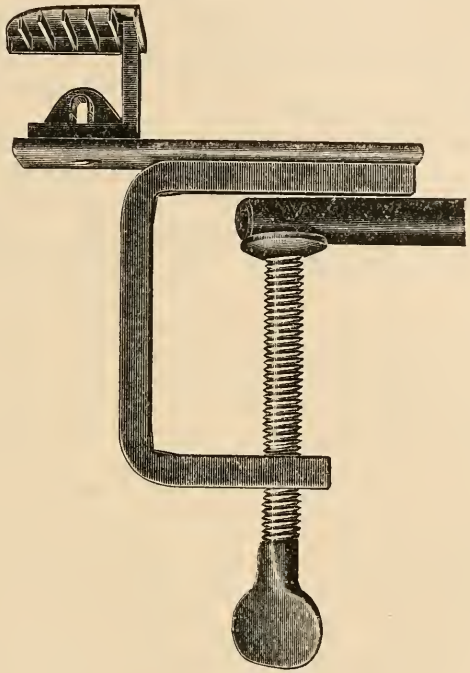


Fig. 138.

freezing-plate is traversed by several metallic ridges. The microtome, which is made by Leitz, is constructed entirely of steel and iron, and is nickeled.

#### (4) Staining and Injecting.

**Staining Nervous Tissue with Gallein.***—H. Schrötter finds that gallein, a pigment belonging to the eosin group, stains the medullary sheath of nerves very well. The dye is dissolved in boiling water.

Sections of spinal cord are immersed in the solution for 15 to 20 minutes, and then differentiated in a 5 p.c. solution of soda. After washing in water and dehydrating in absolute alcohol they are treated with carbol-xylol. The medullary sheaths and medullated fibres are

* Centralbl. allgem. Pathol. u. pathol. Anat., xiii. (1902) pp. 299–300.

stained violet. By washing in dilute permanganate of potash after the soda bath a still sharper picture is obtained.

The best fixative appears to be Müller's fluid.

H. Aronson * remarks that he published the foregoing method in 1890, but his communication attracted little attention, though it contained the important observation that basic pigments attach themselves very firmly to fibres which have been stained red with gallein.

**Modification of the Method for Staining with the Ehrlich Triacid Solution.†**—Morel and Doléris mix equal volumes of the triacid solution and 8 p.c. formalin and then add 1 per thousand acetic acid. The effect of this solution is to fix the methyl-green in the nuclei. The material is best hardened in Zenker's fluid.

The sections should be immersed in the stain for 10–20 minutes.

HEIDENHAIN, M.—**Ueber chemische Anfärbungen mikroskopischer Schnitte und fester Eiweisskörper.** (On the chemical stainings of microscopic sections and of solid albuminous bodies.) *Zeitschr. wiss. Mikr.*, XIX. (1903) pp. 431–41.

„ „ **Ueber chemische Umsetzungen zwischen Eiweisskörpern und Anilinfarben.** (On chemical changes between albuminous bodies and anilin dyes.) *Arch. ges. Physiol.*, XC. (1902) p. 115.

### (5) Mounting, including Slides, Preservative Fluids, &c.

**Staining and Mounting Urinary Sediment.‡**—B. Kozlowski states that he has got mounts of urinary sediment (cells, casts) which have kept unchanged for quite five years. About 1 c.cm. of a weak solution of some aniline dye is added to the urine. A 1 p.c. solution of eosin acts very well. The urine is then centrifuged and the process repeated with the sediment. The last drop of urine is removed. A drop of the thick sediment is then deposited in a drop of Farrant's medium previously placed on a slide. The two are mixed together and then a cover-glass put on. The preparation should be ringed round with a liquid cement made by dissolving caoutchouc in bisulphide of carbon or benzin.

**New Medium for Mounting Microscopical Preparations.§**—According to G. Marpmann, acetyl-cellulose is an ideal medium. It is prepared by treating hydrocellulose with 3 p.c. sulphuric acid at 70° C. and afterwards with acetic acid. On the addition of water acetyl-cellulose separates out and when dried forms a sandy powder which is easily soluble in chloroform, nitro-benzol, &c. As excellent samples are now on the market it is better to purchase.

A good cellulose solution keeps for quite a long time and can always be freshened up by the addition of some more chloroform.

The preparations are removed from alcohol, xylol, or one of the oils (cedar, clove, origanum) to a drop of the solution which has been placed on a slide. Another drop is put on top, and after having been arranged by means of a glass rod a cover-glass is deposited on the surface. The cover-glass may be dispensed with, and this constitutes one of the chief advantages of this medium.

For the cover-glass, cover-slips made of the following solution may

* Tom. cit., pp. 518–20.
† C.R. Soc. Biol. de Paris, liv. (1902) pp. 1255–6.
‡ Virchow's Archiv, clxix. (1902) pp. 161–2.
§ Zeitschr. angew. Mikr., ix. (1903) pp. 1–3.

be substituted : 10 parts acetyl-cellulose, 1 part aluminium palmitate, 15–20 parts chloroform, 1 part nitro-benzol. The solution is smeared on a piece of plate glass until it forms a layer about 0·15 mm. thick. When dry it can be peeled off in strips and cut up into slips of suitable size.

**Method of Mounting Bacteria from Fluid Media.**—In a communication made at the June meeting, J. A. Hill describes a method of mounting bacteria which is based on the principle of gradually changing the microphytes from aqueous to resinous media.

One volume of the fluid containing bacteria is mixed with two volumes of a solution containing equal parts of glycerin and absolute alcohol and well shaken. The sediment from this is treated with absolute alcohol several times to ensure the removal of all the glycerin and water. The fresh sediment is treated in a similar way with oil of cloves to remove the alcohol. After this the bacteria are stained by replacing this reagent by a saturated solution of fuchsin in oil of cloves. After about a week an equal bulk of balsam dissolved in benzol (undried balsam 1 part, benzol 1 part) is added, and this mixture is treated several times with the balsam and benzol solution to remove the excess of fuchsin. To the final sediment is added about three times its bulk of balsam or styrax mounting medium, and from this last mixture microscopic preparations are made in the usual way.

After each step the fluid is allowed to stand until the bacteria are deposited as a visible sediment; the supernatant fluid is then poured off and the sediment used for the next stage, but the process might be hastened by the use of the centrifuge.

### (6) Miscellaneous.

**Microscopical Examination of Foods and Drugs.***—An up-to-date treatise in the English tongue on the microscopical examination of foods and drugs has long been a desideratum. For about fifty years the student of this important branch of science has had to rely mainly on Hassall or on foreign publications. This reproach has now been removed and a long felt want supplied by H. G. Greenish, whose work is specially devoted to instruction in the methods of examining vegetable foods, drugs, and their powders by the aid of the Microscope.

The author has fully succeeded in his task and is to be congratulated on demonstrating that the Microscope is capable of furnishing with the expenditure of a minimum of material, and also often of a minimum of time, information concerning the substances analysed that cannot be obtained by any other means.

The contents are divided into twelve sections arranged so that the student may begin with the simplest and proceed gradually to the complex; e.g. starting with starch, the subject matter deals successively with textile fibres, spores and glands, ergot, woods, stems, leaves, barks, seeds, fruits, rhizomes, and roots. There are two appendices which contain very useful information. The first of these is a list of reagents, with their composition and remarks on their use; the second is a list of the chief varieties of cell-wall and cell-contents, and the means adopted for their identification. The volume is well got up and freely illustrated.

* J. & A. Churchill, London, 1903, pp. 24 and 321 (168 figs.).

## NOTES.

### *An Old Non-Achromatic Simple Microscope.*

By Edward M. Nelson.

This simple Microscope, fig. 143, consists of a triangular prismatic limb, attached to a turned ornamental pillar by a compass joint; concentric with this compass joint is a slotted semicircular brass plate with a clamping screw, to clamp the limb at any required

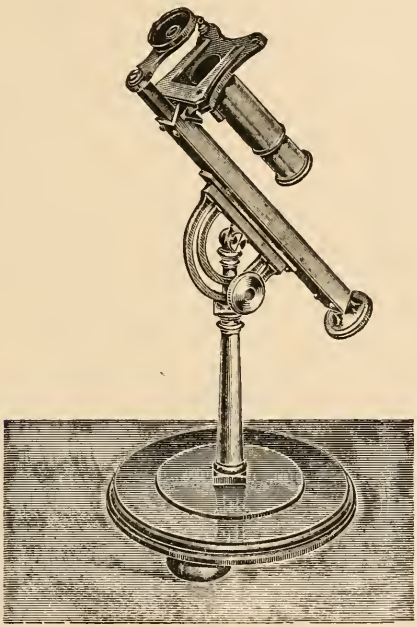


Fig. 143.

inclination. The pillar is fixed to a circular brass base resting on three feet.

The stage has a rectangular clip with two pins fastened below it which pass through two holes in the stage. This form of stage clip first appeared in Jones' Most Improved Compound Microscope *

* George Adams, 'Essays on the Microscope'; the date on Plate 4 is 1797.

and lasted many years, for it is found in the Lister-Tulley,* the first achromatic Microscope, and again in the Ross-Valentine,† and we still find it in the Ross dissecting Microscope ‡ of 1855.

We now pass on to the triangular prismatic limb. The first Microscope to have a triangular limb was the large Benjamin Martin Microscope, in our Cabinet, the date of which may be placed at 1770. This limb was fixed, and the stage, for the instrument was a stage focusser, racked up and down upon it. The next time we hear of a triangular limb is in Varley's description § of a "Microscope for live Objects," this instrument was made by Powell. Although, for reasons stated, Varley did not apply the triangular limb to his Microscope, he says, "my late uncle about thirty years ago introduced the triangular bar and triangular tube. . . ."

In Valentine's Microscope, made by Ross (1831), the triangular limb, however, is reintroduced. Again we have it in Pritchard's Microscope, figured in his *Microscopic Cabinet* 1832; this Microscope was made by Powell, and was a modification of Varley's. So we see that Varley suggested the reintroduction of the triangular limb, Ross first adopted it in Valentine's Microscope, and Powell, following Ross' lead, used it in the Microscopes he made for Pritchard.

There is no coarse adjustment, but a fine adjustment screw, placed at the bottom of the limb, acts directly on the triangular focussing bar. This part is copied from Varley's Microscope, but, as his sprung nut ‖ is omitted, the loss of time is very great.

Beneath the stage is a sub-stage condenser in a sliding tube fitting; its optical part consists of a sliding convex lens.

The objective is a single bi-convex lens of 1 in. focus; it is mounted precisely like the Wollaston doublets of that period. The gauge of the mount is 0·618 in., and some similar, but signed, examples of Andrew Pritchard were found to vary between 0·614 and 0·619. The foot is circular; we find that Microscopes on circular feet are figured in the second edition of Pritchard's *Microscopic Illustrations*, 1838, pp. 82 and 88, figs. 11 and 12.

I have examined the tongue of a blow-fly with this instrument, and was quite surprised at the high quality of the image.

This Microscope was probably made by Powell for Andrew Pritchard, circa 1835–40.

This instrument possesses two points of interest.

1. It is an undoubted early example of the reintroduction of the triangular focussing bar.

2. It is also an early example of a circular foot.

* Journ. R.M.S., 1900, p. 551, fig. 146. † Op. cit., p. 425, fig. 104.
‡ Idem, p. 428, fig. 109, and Quart. Journ. Mic. Sci., vol. 3, p. 220, fig. 15.
§ Trans. Soc. of Arts, vol. 48, p. 12 (1832), and Journ. R.M.S., 1900, p. 283, figs. 70, 71. ‖ Journ. R.M.S., 1900, p. 284, fig. 72.

I have much pleasure in offering this instrument to the Society for its Cabinet.

As the evolution of the prism bar has been alluded to above, it might not be out of place to append a diagram of the section of the various bars.

Fig. 144.

Fig. 145.

Fig. 146.

Fig. 147.

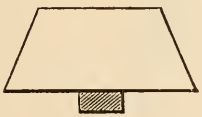


Fig. 148.

1. Benjamin Martin, with internal rack, 1770, fig. 144.
2. Ross-Valentine, angles slightly truncated, 1831, fig. 145.
3. Powell's, a cylindrical bar with three faces planed off, 1833, fig. 146.
4. Powell's next form was merely an enlargement of fig. 145, 1843.
5. Ross abandons the triangular for a rectangular parallelopiped, 1851, fig. 147.
6. Powell's truncated prism, now in use, 1861, fig. 148.

In the above figures, the shaded portion in each case represents the rack.

## *An Early Compound Microscope with a Mirror attached to its Limb.*

By Edward M. Nelson.

This old Microscope will on examination be found to possess some points of interest. A very cursory glance at fig. 149 shows that it is home-made by some ingenious amateur. The body is composed of three brass tubes sliding into each other. These obviously were not intended for draw-tubes, but merely for the convenience of fixing the lenses in their proper positions. The lenses are held in their place by split wire rings; the diaphragms are made of cardboard. The lenses are four in number, two of which form a Huyghenian eye-piece, the third being the back lens of the objective, after the plan introduced by Benj. Martin.

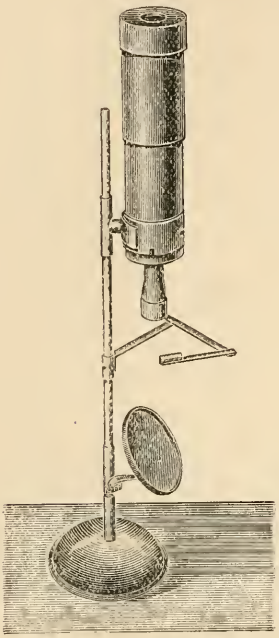


Fig. 149.

The limb is merely an iron rod, attached to a heavy circular foot. The stage is elementary in the extreme: it has a socket to hold the stage forceps, but a slip can be laid across the bars when they are bent round. The objective merely pushes on to the nose-piece without any screw.

The ball and socket for the mirror is of a very simple and ingenious construction, and it will be noted that the mirror is attached to the limb. This is an important point, for it took some years to arrive at the obvious improvement of attaching the mirror to the limb.

The mirror was first applied to the Microscope by Hertel in 1715, but then, as also in the Culpeper and Scarlet (1738), and John Cuff (1744), the mirror was attached to the box-foot. We first meet with a mirror attached to the limb in a *simple* Microscope, viz. that of Lindsay* (Invented 1728, Patented 1743); a signed, dated (1742), and numbered (No. 22) example being in our cabinet. The next instance where we find it is in Ellis's Aquatic Microscope,† 1755; but the example before you is probably the

* Journ. R.M.S., 1895, pl. 4, p. 257.

† Figured in many books besides Mr. Ellis's work on *History of Corallines*; probably the most accessible is *Adams on the Microscope*, 1798, pl. 7 B.

earliest *Compound* Microscope that has its mirror attached to the limb.

In fixing the date of this Microscope we can assume that it is an instrument made by an amateur on the lines of some model before him. Now the Microscope he has evidently copied is that of Benjamin Martin (1760–1770) * ; a signed and numbered (No. 1) example of which is in my possession.

It probably is not older than 1715, the date of the introduction of the mirror, neither earlier than 1760–1770, because its object-glass has a back lens ; but, evidently, it is an old instrument made in the latter half of the eighteenth century. I have much pleasure in offering this instrument to the Society for its acceptance.

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## *An Improved Horseshoe Stage.*

By Edward M. Nelson.

While working with a high power on a Microscope with a plain stage, having only a circular hole in it, great inconvenience was experienced in tilting the slide on its edge, for the purpose of feeling the working distance, when bringing the lens into focus ; it therefore occurred to me that it would be a good plan to cut away all the brass in front of the circular hole and make what is now known as a " horseshoe stage." So in 1880, I asked Powell to cut out the stage of his iron Microscope † for me. The advantage was at once so apparent that I had three other instruments treated in the same manner.‡

This form of stage is now largely used. Although the advantage of this form of stage when ordinary slides are being examined is obvious, yet some objection may be raised when dishes and watch-glasses with convex bottoms are placed upon it, because of their liability to slide forward in the horseshoe opening. I have therefore designed this simple modification which will render this form of stage suitable for all purposes.

A flat plate of brass with a circular hole in it, having tongues at the edges to slide in grooves cut to receive them, is pushed into the horseshoe opening, when dishes, etc. are required to be placed upon the stage. When ordinary slides are to be examined the brass plate is withdrawn, and the horseshoe stage is left in its original condition.

* Journ. R.M.S., 1898, p. 474, fig. 81.

† Idem, 1899, pp. 209, 210, figs. 44 and 45, and 1900, pp. 289–291.

‡ Idem, 1883, p. 554, fig. 94 ; and 1887, p. 293, fig. 41, and p. 1013, figs. 238 and 239.

Fig. 150 (scale $\frac{1}{2}$) shows the horseshoe stage with the brass plate *in situ*, and fig. 151 shows the brass plate when withdrawn. In fig. 150 the X shows the optic axis, and it will be noticed that from the X to the top of the sliding bar is $1\frac{1}{2}$ in. (38 mm.), which is equal to the distance from the X to the top of the stage; therefore a slide $1\frac{1}{2}$ in. (38 mm.) wide can be examined from its

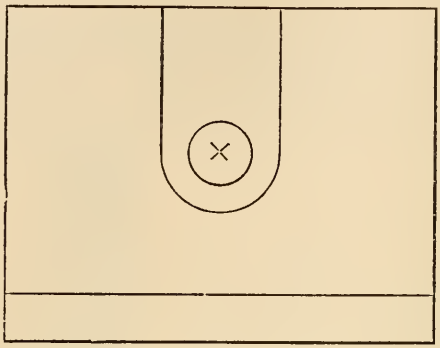


Fig. 150.

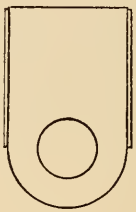


Fig. 151.

top to its bottom edge; also $\frac{3}{4}$ of an inch (19 mm.) of sideway movement can be given to a slip 3 in. (76 mm.) long, on each side, without causing the end to project beyond the stage. This means that a $1\frac{1}{2}$ in. (38 mm.) square on a slide measuring 3 by $1\frac{1}{2}$ (76 by 38 mm.) can be searched over without any portion of the slip projecting beyond the edge of the stage. The two lines at the bottom of fig. 150 indicate the sliding bar, but the lugs are not shown.

## MICROSCOPY.

### A. Instruments, Accessories, &c.*

#### (1) Stands.

**Leitz' New Stand and Fine Adjustment.**†—In this new model (fig. 152) Leitz has adopted the English method of applying the micrometer screw to the tube, and has, at the same time, abandoned the

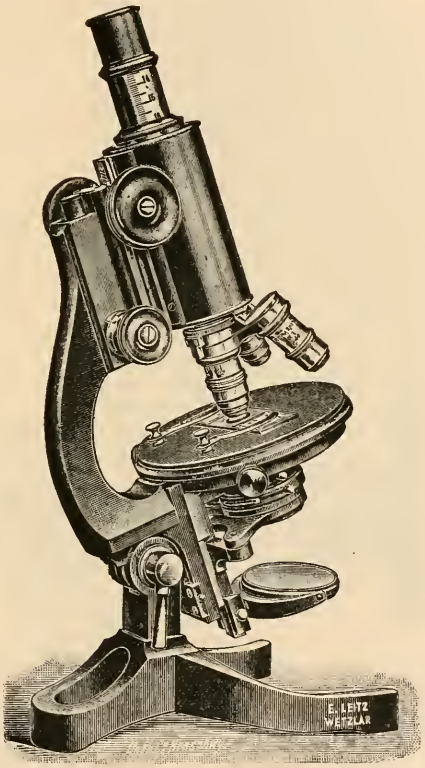



Fig. 152.

Continental type of stand. The build of the Continental stand is a necessary consequence of the straight tube and straight pillar of the upper part: hence, in the present stand greater freedom has been

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Zeitschr. f. Instr., xxiii. (1903) pp. 79–81 (3 figs.).

attained in the disposition of the pillar and foot. The curving of the upper pillar affords a good grip for the Microscope and provides ample room for a large object-stage. In place of the usual mechanism of screws, levers, or inclined planes, a principle, apparently novel as regards the Microscope, has been adopted for the attainment of a fine adjustment: a disc (*f*, fig. 153) rotates about a strong axis and is bounded by a curved surface excentrically placed with regard to the axis: this disc raises the tube the desired distance. Fig. 153 is a vertical section through the mechanism of the micrometer adjustment. The periphery of the disc is made of two equal spirals which are placed together in a

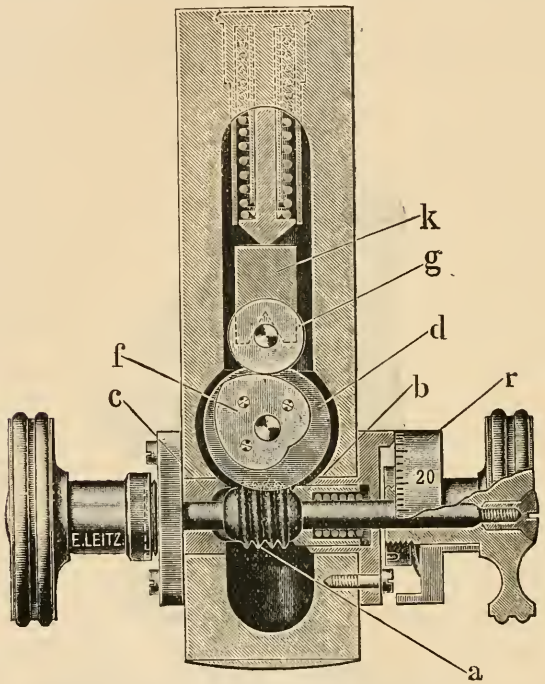



Fig. 153.

heart-shaped manner, thus forming a kind of cam. The spiral starts from the indent of the cam (i.e. the point nearest the rotation-centre) up to its apex: the range is about 3 mm., and the disc simultaneously travels an equal amount. A support *k* is placed on this spiral by means of the roller *g*; it shares in the movement and communicates it to the tube. The heart-shaped piece is rigidly connected with a toothed wheel *d*, which engages on two sides in the thread of an endless screw *a*. This double engagement of the teeth and axle is clearly seen in fig. 154. This endless screw is operated by a pair of milled heads placed under the milled heads of the coarse adjustment. The position *b* of the

endless screw *a* brings the latter by means of the unilateral pressure of a spring into close contact with the toothed wheel. By means of this pressure-position and the double gripping of the wheel and axle all backlash of both is avoided. The toothed wheel has 60 teeth and requires a half rotation to move the spiral from the indent of the cam to its apex and to perform the 3 mm. of motion. In one rotation, therefore, one tooth corresponds to a movement of 0·1 mm.; and a complete rotation of the axis *a* secures a complete rotation of the toothed

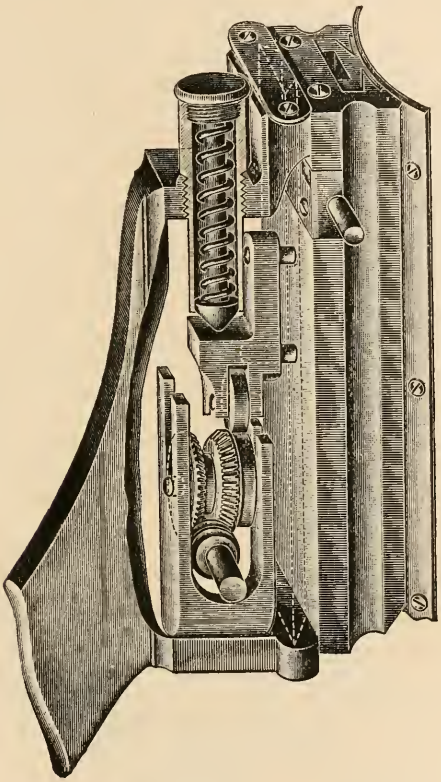


Fig. 154.

wheel. The drum *r* of the axis is divided into 100 parts: the rotation of one graduation of the drum-head corresponds, therefore, to a micrometric movement of 0·001 mm. The connecting piece between tube and pillar carries the rack-and-pinion coarse adjustment and bears on its hinder side a swallow-tailed piece fitting accurately into a corresponding groove of the pillar, and firmly screwed on to the bearer *k*. This bearer by means of the roller *g* sits on the surface of the spiral and shares both its rising and its falling movement. A spring inserted in a cylinder on the pillar of the stand over the support *k*, presses a pin

against the support and holds the roller in sure contact with the spiral. The pin is so situated on the support *k* behind the contact-point of roller and spiral (see fig. 154) that the spring-pressure and the strain arising from the weight of the tube and connecting piece equalise themselves, so that within the groove of the swallow-tail there is no side pressure on the sliding parts to affect the fine adjustment, and thus an unequal wear and tear of the guide surfaces is avoided. One effect resulting from the connection of the two spirals to the cam is that, owing to the endless action, there can be no over-winding and therefore no straining of the fine adjustment. Another advantage is that destruction, in the event of contact, of the cover-glass cannot occur, even if rotation of the screw is continued, for in this case the connection between roller and spiral is interrupted : the spiral then runs free, the tube gently sets itself on the cover-glass which, in the designer's experience, is capable of sustaining the weight of the light aluminium tube and the pressure exerted by the spring on the tube-holder and tube.

In connection with the foregoing stand and with special reference to the fine adjustment Mr. Nelson writes as follows :—

"The circular issued by Messrs. Leitz of Wetzlar throws an interesting side light on the ideas prevalent in Germany with regard to Microscope construction.

One of the causes assigned by Messrs. Leitz for the difference in construction of the Continental and English models is very curious—it is as follows : 'The shape of the Continental stand is largely determined by the straight tube and the straight pillar, which are indispensable, owing to the long prismatic guides in the pillar.' Many English Microscopes, however, have straight tubes and longer prismatic guides than exist in any Continental model, so that these points can hardly be said to determine the form of the model.

The truth is, that the non-inclining Continental model, with its small stage, was a cheap form, which did well enough to hold the magnifying glasses for which it was originally designed, but the moment it was used for purposes of delicate research it utterly broke down, for it was found wanting in every important point.

Messrs. Leitz admit that it fails when the stage is enlarged, and the distance of the body from the limb is increased, and anyone can understand how the weight of the body, acting at the end of the arm (virtually a lever), must jam the slides. This surely is an important point, for if the fine adjustment breaks down what is the use of the instrument ?

The method which Messrs. Leitz have adopted in their laudable attempt to improve the radically bad Continental model is both complex and quite inefficient. The body is raised and lowered by a cam, which is rotated by an endless screw ; the speed attained is $\frac{1}{254}$ in. for each revolution of the pinion.

Passing over, without criticism, the complexity of this mechanism, it can be seen at once where the appliance fails, for it is impossible to determine the direction of the focussing movement, whether it is upwards or downwards. This, however, is a point of primary importance

in a Microscope, because there is no stereoscopic projection, and the shape of bodies can only be known by differences of focal adjustment.

The instrument, like all of Messrs. Leitz' work, is most beautifully made, and it is a thousand pities that Germans throw away such excellent work on such impossible models.

The cam was first applied to the fine adjustment of a Microscope by Wenham in 1886, but it was used for stage movements by Swift in 1884." *

**New Regulating Arrangement for a Hot Stage.**†—The advantage of this apparatus, designed by R. Kraus, is "that a constantly warmed water-supply can be applied to an object-stage and keep it at a constant temperature the whole day long." The apparatus consists of a glass hollow stage communicating by means of indiarubber tubes with the two chambers of a heated reservoir. The whole arrangement involves the principle of circulation, and the effect is to produce a steady flow of water at a constant temperature through the stage. The water on leaving the stage goes to the lower chamber, which is a sort of furnace, whence it rises to the reservoir proper; thence it gravitates to the stage, and so on. The heating of the furnace is effected by a suitable gas flame, and a thermostat in the reservoir controls the temperature of the flow. The temperature of the stage is about 8° C. less than that of the reservoir and the object-holder would be about 4° C. still lower.

**Watson's New Scōp Mechanical Stage.**—The principal advantages offered by this new stage exhibited at the June Meeting (fig. 155)

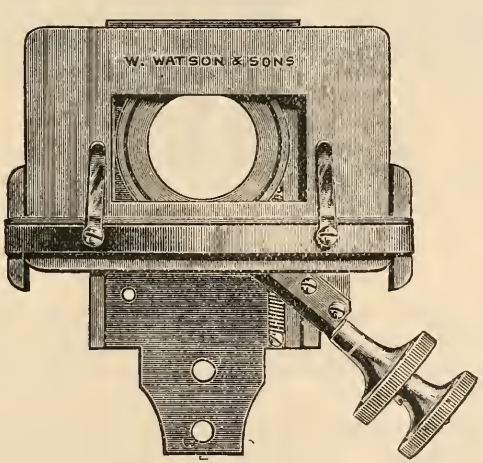



Fig. 155.

are great range of movement, as much as 3 in. being given in the horizontal direction, and a clear surface for working purposes. The

* This Journal, 1886, p. 1052 (figs. 220 and 221).

† Centralbl. f. Bacteriol., xxxii. (1902) p. 467; and Zeit. f. Wiss. Mikr., xix. 1903) p. 347 (1 fig.).

two movements are effected by rack-and-pinion, by which an equal rate of progression is secured: they are actuated by two milled heads mounted on a common spindle on the Turrell system, and though the position of the heads is unusual it is found in practice to be extremely convenient. In size the stage is the same as that of the "H" Edinburgh Student's Microscope, but if desired it may be removed and replaced by a plain plate fitting in the same dovetails.

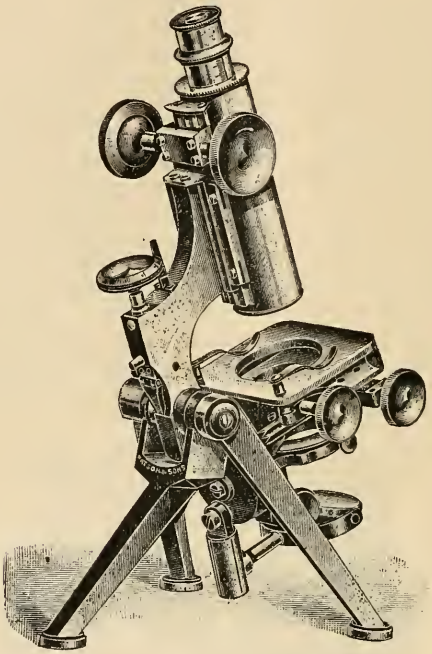


Fig. 156.

**Watson's New Pattern Portable Microscope.**—Figs. 156 and 157 show the new pattern portable Microscope which was exhibited and described by Mr. F. W. Watson Baker at the Meeting on June 20th: see *ante*, pp. 562–3.

**New Microscopical Stand with a Movable Stage capable of Large Movements.***—Cl. Regaud and Nachet describe a stand which has a special form of movable object-stage and is geared so that the stage can be moved up and down. The stage is adapted for large object-slides 85 by 50 mm., and by means of a mark the object-holder can always be accurately brought back into the same position. Every part of the upper surface of the object-holder can be brought into view and

* Arch. d'Anat. Micr., v. (1902) pp. 17–21 (2 figs.).

the whole surface can quickly or slowly be systematically explored. The movements are controlled by the left hand of the operator, his

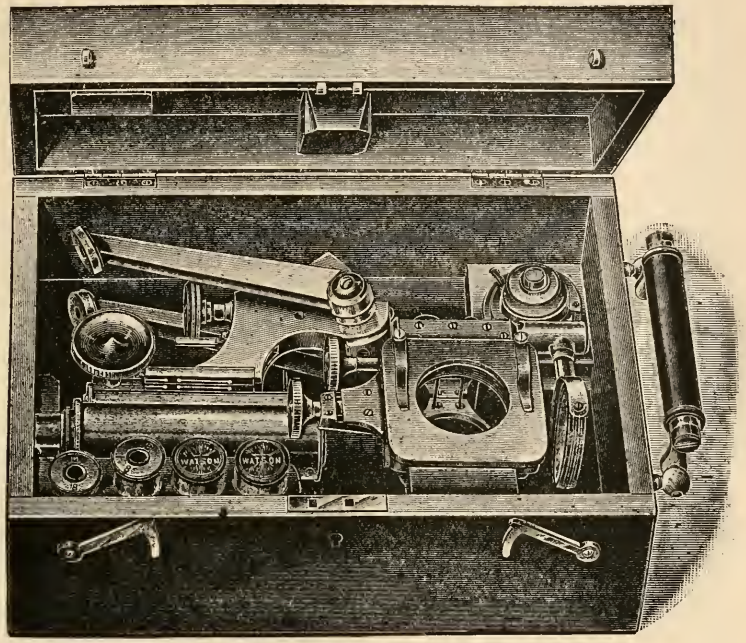


Fig. 157.

right being then free for the micrometer screw. The apparatus is thus especially suitable for the examination of a series of sections.

### (3) Illuminating and other Apparatus.

**Colour Illumination of Microscopic Objects.***—S. E. Dowdy describes a simple procedure for making coloured gelatin discs for illuminating objects by Rheinberg's method.† First of all, obtain an ounce of good quality clear gelatin. Shred this up into small pieces and cover them with 4 oz. of water, and allow it to stand till quite soft; then add another 2 oz. of water, and warm gently on a water-bath (a saucepan containing a little water will do) until the gelatin dissolves. This will constitute our stock solution, which may be coloured as follows:—Procure half a dozen of the penny packets of anilin dyes, selecting brilliant contrast colours. Add about four grains

* English Mechanic, lxxvii. (1903) p. 324.
† See this Journal, 1893, p. 373; 1899, p. 142.

of the dye to a teaspoonful of water; warm until dissolved; filter if solution contains any foreign matter, and add it to about an ounce and a half of the stock solution of gelatin whilst still warm, and therefore in a liquid condition. Now clean some $\frac{3}{4}$ in. circular cover-glasses and place them on a sheet of white paper. With a glass rod deposit a little of the warm gelatin solution on the centre of one of them, and quickly lower upon it another cover-glass, pressing it down to remove superfluous liquid. The gelatin will set almost immediately, with the result that a thin film of it, protected on both sides from injury, will be obtained. Such films can be cleaned like an ordinary cover-glass with no fear of their coming apart. Some background stops will now be required, and these can be prepared as follows. With a fine camel-hair pencil paint a circular disc of the coloured gelatin solution in the centre of a cover-glass, and allow it to dry. Care should be taken to put it on thinly and evenly, and a neater job will be made of it if a fine ring of varnish be first put on the cover with a turntable, afterwards painting in the central area. Two or three dozen films should be prepared whilst the materials and solutions are about, as they are always handy.

**Early Glass Micrometers.**—Mr. E. M. Nelson presented at the June Meeting two micrometers for the cabinet of the Society, and has supplied the following description. These two micrometers are interesting as being early specimens of a glass micrometer. They are ruled on the slides (2 by $\frac{3}{4}$ in.), and no cover-glass is used. They are both ruled in squares, one in $\frac{1}{100}$, and the other in $\frac{1}{200}$ of an inch. I have compared the $\frac{1}{200}$ with an accurate micrometer with some care, and find that the average of the $\frac{1}{200}$ is slightly in excess, viz. $\frac{1}{198}$. The greatest interval is $\frac{1}{190}$, and the least $\frac{1}{206}$; probably an error of two units in the fourth decimal place was not thought much of in those early days of micrometry; one of the interspaces however is only $\frac{1}{11400}$ in. in excess. The $\frac{1}{100}$ was only cursorily examined, but the ruling seemed more even; but the error, like the other, was in excess of the truth.

Probably these micrometers were ruled by Powell, as they belonged to a Microscope made by him in 1838.

**Method of Demonstrating Newton's Colours by Transmitted Light.***—It is well known that, if white light be passed through a thin film, part of it will be reflected twice within the film and will cause interference and colour phenomena. These are usually very faint because the amount of light which is thus reflected is so small as compared with what passes directly through, as to have but a slight effect. If, however, the same wave-front be passed through a uniform series of films, successive portions of certain colours should be blotted out in each film, while other colours which get through the first film without interference, should emerge from each of the other (similar films) without interference, and the colour effect should be cumulative. At the suggestion of Prof. Barus, these surmises have been empirically verified and excellent results obtained. If a number of wire rings of the same

* Amer. Journ. Sci., xv. (1903) pp. 224-5.

size be mounted in parallel planes, and dipped together into a soap solution, their planes being kept perpendicular to its surface, a suitable series of films results, through which light can be passed and caught on a sheet of paper, showing the desired phenomena very beautifully. Since each film, under the action of gravity, is a very thin wedge, the colours are in horizontal bands, appearing first at the top (where the wedge is thinnest) and moving slowly down across the field as the films evaporate, to be succeeded by other bands of lower orders. Indeed, good films will often hold until two-thirds of the field is coloured with the yellowish-brown of the first order. If the paper be replaced by a good lens and the colours projected on a large scale upon a suitable screen they can be strikingly demonstrated to a class. In practice the important thing seems to be uniformity in size and alignment in the set of rings. The author makes them of 5·5 cm. in diameter, of galvanised iron wire ($d = 1·25$ mm.), the ends being twisted together into a sort of handle. Such rings can be temporarily strung on three rods notched at appropriate intervals to insure parallelism in the planes of the rings, while the handles are being clamped between two pieces of soft wood. The rings should be at least a centimetre apart to avoid cylindrical and irregular films, and from fifteen to thirty are sufficient. Before the films have become thin enough to show colours, certain other interesting phenomena of a circulatory nature are noticeable and can be studied.

**Wide Illuminating Cones.***—"Villagio" expresses his gratification as to the improved results he has obtained by the use of wide-angled condensers and apertures. He was particularly pleased with the appearance of *A. pellucida* mounted in realgar, the objective oil-immersion being 1·35 N.A., and the condenser worked up to rather over 1·0 N.A. immersed. The lines were exquisitely sharp with widest axial cone, and on removing the eye-piece the two spectral beams were seen partially eclipsed by the edge of the back lens. On closing the diaphragm it was instructive to note that these beams diverged until they disappeared, this happening at about ·8 to ·9 N.A. On using the eye-piece with this cone it was, of course, found that the lines were invisible. The writer has also found the same arrangement of lenses and illumination excellent on sections of well-stained material, beautifully clear images being obtained. Similarly satisfactory results were obtained with living bacteria.

J. Rheinberg,† however, in discussing Villagio's communication, points out that arguments in the controversy of wide-angled *versus* narrow-angled cones are apt to overlook the nature of the object to which such cones may be applied, and that great caution should therefore be employed before any hard-and-fast rules be adopted. After discussing the effects produced by various kinds of illumination he concludes by pointing out that "whilst wide axial cones of illumination may cast a haze over, or completely obliterate the appearance of structure, they cannot, save in very exceptional circumstances, create an appearance of false structure, whereas as soon as we proceed to narrow cones, or use oblique,

* English Mechanic, lxxvi. (1903) p. 463. † Tom. cit., pp. 524–5.

or annular illumination, such appearances are frequently created. Necessary as the latter modes of illumination may at times be, they require far more care in interpretation than anything that can be seen with a wide cone of light."

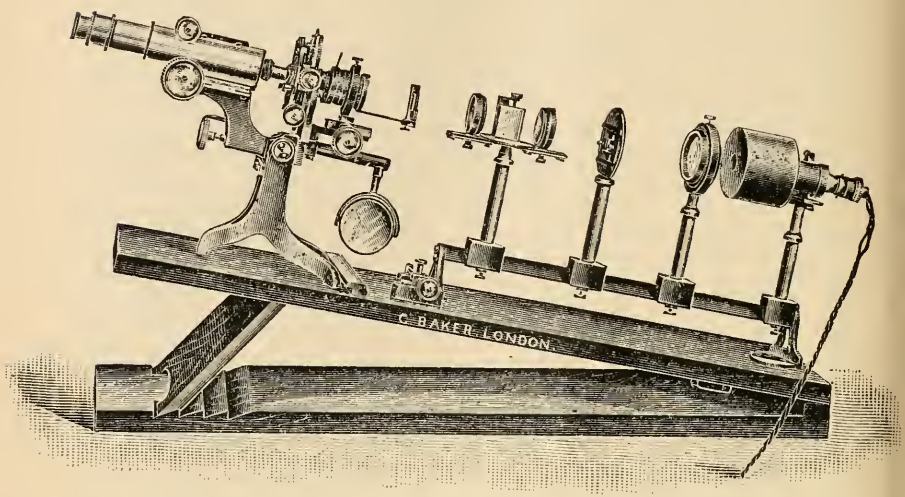



Fig. 158.

**Monochromatic Light Apparatus.**—Fig. 158 illustrates the apparatus exhibited and described by Mr. C. L. Curties at the Meeting held on May 20th : see *ante*, pp. 378–9.

Macé de Lépinay, J.—**Projections Stéréoscopiques.** *Journ. de Phys.*, 1902, p. 311.

#### (4) Photomicrography.

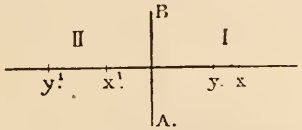
**Stereoscopic Photomicrography with Weak Magnification.*** — W. Scheffer's explanation of the theoretical principles underlying the preparation of stereoscopic photographs of microscopic objects are set forth in figs. 159 and 160. The magnification is supposed to be weak, and for such films photographic objectives of short focus without oculars suffice. X, Y are the points intended to be stereoscopically presented in magnification. The objective O, with the camera and ground glass screen, is first of all set perpendicularly to the object plane (C D, E F, are the planes ; A B, the optic axis). M is the point at which the optical axis of the two positions of the objectives intersect with the axis of the camera. This point must come exactly in the centre of the object ; it is then only necessary to provide for the movement of the objective and of the focussing screens. The camera is first moved to the right and then equally to the left (into the positions M H, M G) ; the result being that projections are received on the screens P' P' and

* Zeitschr. wiss. Mikr, xix. (1903) pp. 289–96.

P P, which give the single images of a stereogram and represent the relative positions in space of the points X, Y.

Fig. 160 shows the final arrangement of the single pictures i. and ii. for the stereogram. The combination-points ($x$ and $x_1$) corresponding to X lie closer together in the stereogram than those for Y ($y$ and $y'$); X is therefore presented to the observer nearer than Y. Two conditions

Fig. 159.



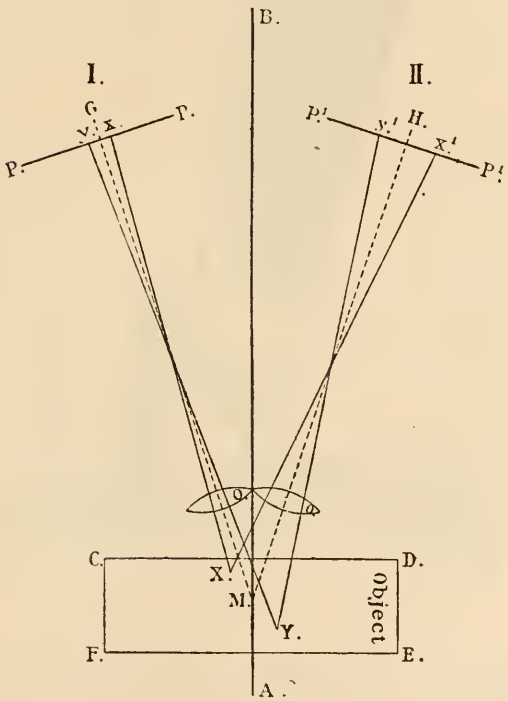




Fig. 160.

are necessary for success: first, that the points X and Y must lie within the penetrating power of the objective; secondly, the object must not project so far from the object-plane that the side views exceed those same limits of penetration. The "angle of inclination" is the inclination of the optic axis of the camera to the vertical, and it is found that an inclination angle of 3° gives the best results.

The arrangement of the apparatus is shown in fig. 161. A strong pillar B B rises perpendicularly from the base and bears a pivot D, round which is a movable arm C, whose (partial) rotations give the lateral inclinations of the camera. The angle of inclination can be accurately read off to $\frac{1}{4}°$ on the scale at F. The screw B serves as a clamp. The coarse adjustment of the objective is effected by a push-motion of the lower part of the camera on the pillar T ; the fine adjustment is by rack-and-pinion. When a stereoscopic plate is to be taken a pin is thrust through the hole visible in D, and its point accurately marks the inclination axis. The camera is, however, first brought into

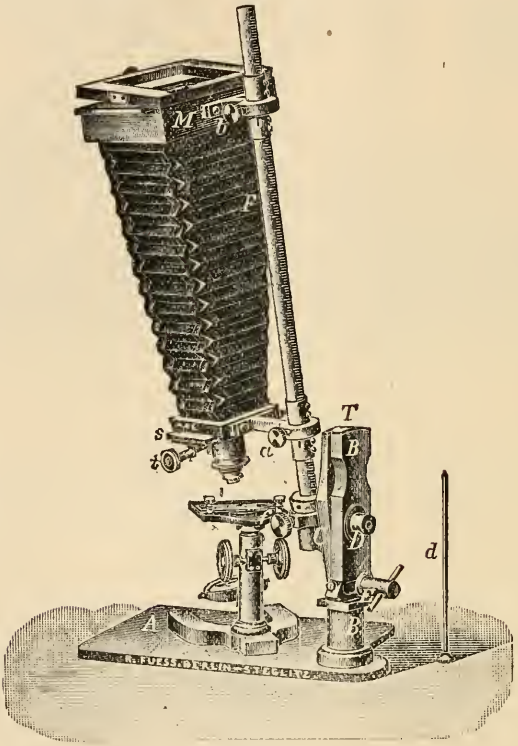



Fig. 161.

the proper position for the negative and is clamped by the screw *f*, as the pin must also pass through a hole in the pivot of F. The point of the pin, as well as the objective, is now finely adjusted, and, by means of slight lateral movements of the objective board combined with slight push movements of the pin, is brought into the centre of the focussing screen. The frame is so arranged that the perpendicular to the centre of the screen intersects the rotation axis. When the image of the pin-point has been thus sharply defined in the centre of the screen, the objective is orientated and the pin drawn out. The stage with the object is then so orientated on the foot-plate that the

image of the object-centre comes in the centre of the screen. The fine adjustment of the screen image is effected by the raising and lowering of the object. In this way the object is brought into the intersection of the optic axis of the camera and of the inclination axis. The illumination, especially with reflected light, is of the highest importance and should, as far as possible, fall perpendicularly on the inclination plane ; otherwise, the two stereograms would be unequally illuminated.

The apparatus is made by R. Fuess & Co.

**New Method of Focussing in Photomicrography.***—Katharine Foot and Ella C. Strobell add some notes on their method of focussing.† This method offers special advantages for the vertical camera and daylight illumination, as it does away with the use of the ground glass, a minus spherical lens being substituted for the purpose of focussing. These lenses can be obtained from any optician, and a series (omitting the half numbers) ranging from − 1 D to −12 D, will furnish the equipment necessary for photographing at 1200 diameters or less, with most combinations of objective, eye-piece, and bellows drawn. The lens for a definite magnification depends upon the eyesight of the operator. The selection of this lens is a simple matter and can be determined by taking one photograph. The method, in brief, is as follows :—"Instead of attempting to focus on the ground glass fine details impossible to see with daylight illumination, the change of focus necessary to throw the exact image (selected for the photograph) on the ground glass, is accomplished by focussing *through* a minus spherical lens placed on top of the projection ocular. This lens is removed before the plate is exposed. The *photograph* is not taken through the lens. The use of these lenses is simply a device for compelling the eye to see the plane of the preparation that is projected on the ground glass." Before exposing the plate a delay of a few minutes is necessary to see that the focus does not slip. It is also necessary to see that such a length of draw-tube is used as will give agreement in results as tested by the Zeiss stage micrometer and by the Zeiss micrometer eye-piece. A few photographs of the stage micrometer, taken with different combinations of lenses and bellows draw, provide an accurate register of magnifications, in convenient form for reference in selecting the lenses and draws needed for a given magnification. In using this method of focussing, it is a great aid to determine the limits within which a sharp focus can be expected, for it is easy to strain the eye and see details beyond these limits ; the negative in this case giving disappointing results.

**Photographic Lenses.**‡—Under this title, C. Beck and H. Andrews have compiled a book intended for the use of the non-mathematical photographer. But so much of the work is occupied with an explanation of the properties of lenses that it cannot fail to be of interest to microscopists. The diagrams and illustrations are very numerous, and the plates devoted to such subjects as curvature and distortion are remarkably effective.

* Journ. App. Micr., v. (1902) pp. 2082–4 (1 fig.).

† Zeitschr. wiss. Mikr., xviii. (1902) pp. 421–6 (1 pl.) ; and this Journal, 1902, pp. 490–1.

‡ Published by R. & J. Beck and Percy Lund, Humphries & Co. (second edition) London.

#### (5) Microscopical Optics and Manipulation.

EVERETT, J. D.—**On the Resolving Power in the Microscope and Telescope**
*Rep. British Assoc. Glasgow*, 1901, p. 569.

STREHL, K.—**Ueber Luftschlieren und Zonenfehler.**
*Zeit. f. Instrumentenk.*, XXII. (1902) p. 213.

VOLKMANN, W.—**Ein neues Geradsichtprisma und ein neues Flüssigkeitsprisma.**
*Ann. d. Phys.* [4] VIII. (1902) p. 455.

#### (6) Miscellaneous.

**The Microscope.***—Under this title, A. S. Percival contributes to the *English Mechanic* a brief but clear and interesting explanation of the peculiarities of lens structure concerning the Microscope. He deals, *inter alia*, with magnification, spherical aberration, chromatic aberration, apochromatic objectives, size, brightness and flatness of image, and Huyghenian eye-pieces.

**Wave-length Tables of the Spectra of the Elements and Compounds.**
*Rep. Com. Brit. Assoc.*, 72nd Meeting, Belfast, 1902.
London (J. Murray) 1903, pp. 137–74.

### B. Technique.†

#### (1) Collecting Objects, including Culture Processes.

**New Economical Thermostat of Simple and Light Construction.‡** C. Tonzig describes a thermostat which can be easily and cheaply made by an ordinary joiner and tinsmith, and which is well adapted for a temperature of 20° or 22° C. It measures 40 × 60 × 75 cm., and is made of wood, 2 cm. thick. Through the middle of the chamber a cylindrical tube of zinc passes vertically. This cylinder extends 5 cm. above the roof of the chamber, and below the floor it expands in the form of a cone, which is closed at the bottom by a plate of copper, this part being exposed to the flame when the thermostat is in use, and the cylinder full of water. The upper end of the cylinder has in it two openings, one for the thermo-regulator and another for a thermometer, to gauge the temperature of the contained water. In the roof of the chamber near one of the sides is another opening for a thermometer, to gauge the incubator temperature. The diameter of the cylinder is 7·5 cm., that of the base of the cone 18 cm., its capacity, therefore, is about 4900 ccm. The author uses a Soxhlet's thermo-regulator, but when gas is not available, a constant temperature can be maintained by the use of one or more night-lights in oil. The air of the chamber is warmed by convection of heat given out from the cylinder. The temperature was found by experiment to be uniform in all parts of the upper part of the thermostat. In the lower part the temperature was a

* English Mechanic, lxxvi. (1903) pp. 430–3 (15 figs.).

† This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.: (6) Miscellaneous.

‡ Centralbl. Bakt., 2te Abt., x. (1903) pp. 531–4 (1 fig.).

little lower (·5°–1·5° C.). With regard to constancy of temperature, it was found that with a fluctuation of 8° C. in the room temperature, the change in that of the thermostat did not amount to 2° C. With slight fluctuations in the room temperature, that of the thermostat may be regarded as constant. The approximate cost of the apparatus, with thermo-regulator, thermometers, rubber tubing, and lamp, is from 25 to 30 fr.

**Milk-Agar as a Medium for the Demonstration of the Production of the Proteolytic Enzyme.***—Referring to papers by E. v. Freudenreich and J. Thöni, and by E. G. Hastings,† C. Eijkman claims priority in suggesting the use of milk-agar for the above purpose, and in showing that the clearing of this turbid medium depends on the peptonising of the casein and that the casein-splitting enzyme is identical with the gelatin-liquefying one. He argues that while both milk-agar and gelatin are useful in distinguishing between peptonising and non-peptonising colonies, the former had the advantages of not liquefying and of a higher melting-point. The author also advocates the use of the "Diffusionsmethode" for the demonstration of the production of the fat-splitting enzyme.

### (2) Preparing Objects.

**Decantation Method for Cleaning Diatoms.‡**—S. Broughton remarks that diatoms should be treated with acid to clear from all soluble matter and afterwards poured into a tall glass jar. Then have ready a siphon, and when the coarser particles have settled down siphon off to within an inch of the bottom; then empty the sand into another vessel and pour the portion first siphoned off into the glass jar and siphon off again to within an inch of the bottom. Empty the portion left into another vessel and repeat as often as thought desirable, keeping each separate, and at the last let it stand some time, allowing the diatoms to settle down, and then siphon off the clear water. They should then be fairly free from foreign matter. Each lot may then be tested to see if any diatoms are left in, and if so the process should be repeated.

### (4) Staining and Injecting.

**Apparatus for the quick and uniform Staining of Serial Sections and for the Treatment of them in Number with Reagents.§**—This apparatus, made by R. Jung, of Heidelberg, consists of a glass vessel, 70 × 40 × 90 mm., into which fits a carrier for 10 slides made of nickel wire with sloping cross-bars of tin for the slides to rest on. These cross-bars are turned up at the edge so that the slides cannot fall off. A ring of wire allows the carrier to be lifted out without the fingers coming in contact with the reagent. The glass vessels are very cheap and it is convenient when working to have a number of them, each containing a separate reagent or stain, the carrier holding the slides being lifted from one to the other.

* Centralbl. Bakt., 2te Abt., x. (1903) p. 531.
† Op. cit., 1te Abt., xxix. (1901) No. 22.
‡ English Mechanic, lxxvii. (1903) p. 444.
§ Zeitschr. angew. Mikr., ix. (1903) pp. 57–8.

**Modification of the Romanowsky Stain.*** — H. F. Harris while studying the malaria parasite, found the Romanowsky staining method and its many modifications uncertain. He recommends that, in place of the methylen-blue solution being mixed with the eosin, they should be used separately. His method is as follows :—Place the blood-film in a 1–1000 solution of Gruebler's water-soluble eosin for 30 sec. to 2 min.; well wash and place in a solution containing 2·5–5 parts Unna's alkaline methylen-blue, with distilled water to make 100 parts, for 5–10 minutes if the preparation is recent, longer if it is old. (To this solution 2·5 parts of a 1 p.c. solution of methylen-blue may be added with advantage.) Wash again, and if the film be too blue pour on it a solution of Unna's glycerin-ether mixture made by adding one drop of this compound to 10 c.cm. of water, then after a few seconds wash, and dry without heat. The author claims that by his method very old preparations may be stained. For fixing the films he advocates a few seconds in Reuter's 10 p.c. formalin and alcohol mixture.

Fig. 162.

#### (6) Miscellaneous.

**New Sterilisable Hypodermic Syringe for Aseptic and Bacteriological Injection Experiments.†**—Made by Christian Kob and Co., Stützerbach. The syringe described (fig. 162) is not really new, having been made by the same firm for several years. It consists of an inner glass tube A almost closed at one end, a small hole ·5–1 mm. wide being left. At the other end there is first a constriction K, then a bulging W, and lastly a cone C ground to fit the hollow needle. The lower two-thirds of this tube are graduated up to 10 c.cm. outside, and two-thirds the length of A is another glass tube B wholly closed at the end. It is connected with A by means of a rubber ring G which while taking a firm grip of B is able to slip up and down A easily but hermetically. When B is drawn out the liquid to be injected is drawn up into A, and when the movement is reversed it is expelled. Simplicity, cheapness, and easy sterilisability are claimed for the syringe; also that it can be used with one hand, and can be laid down when full or even inverted.

**New Method of Counting the Corpuscles of the Blood.‡**—W. M. Strong and C. G. Seligmann. A measured quantity of the blood is mixed with a measured quantity of a fixing solution with which is combined a suitable stain. A measured drop of the mixture is allowed to evaporate to dryness on a slide and then is mounted in balsam. The number of corpuscles, red

* Centralbl. Bakt., 1te Abt. Orig., xxxiv. (1903) pp. 188–91.
† Zeitschr. angew. Mikr., ix. (1903) pp. 58–61 (1 fig.).
‡ Brit. Med. Journ., July 11, 1903, pp. 74–7.

or white, in the whole drop is then counted. In making the solutions the authors advocate the use of tabloids, as follows :—

| *Sol. A (for white count).* | | *Sol. B (for red count).* | |
|---|---|---|---|
| Tabloid { Sodium chloride . | ·25 grm. | Tabloid { Sodium chloride . | ·25 grm. |
| { Methyl-violet . | ·004 grm. | { Eosin . . . . | ·0025 grm. |
| Formalin (neutral) | ·5 c.cm. | Formalin (neutral) | ·5 c.cm. |
| Distilled water . | 30 c.cm. | Distilled water . | 30 c.cm. |

White cell count : 5 c.mm. of blood are mixed with 495 c.mm. of solution A and well stirred. This is allowed to stand for about 5 minutes. 5 c.mm. of this is taken and blown out on a slide so as to form a drop about 10 mm. in diam. This is allowed to dry and is mounted.

The white cells are stained and easily seen. The actual count is made with $\frac{1}{6}$ objective, and the whole drop is gone over in parallel and contiguous lines from field to field. The use of an oblong diaphragm introduced into the eye-piece is recommended for convenience in counting. The count takes from 20–30 minutes. The 1–100 dilution must of course be allowed for in making the final calculation.

Red cell count : 5 c.mm. of the first (methyl-violet) dilution are mixed with 995 c.mm. of solution B ; 5 c.mm. of this are taken and treated as before. This time however the dilution will be 1–20,000.

The dilutions may be modified to suit very high or very low blood counts.

The authors claim for their method permanency of the preparations, and elimination of possible error due to differences in depth of the cells in ruled counting chambers.

Friedberger, E.—**Die allgemeinen Methoden in der Bacteriologie.**
Jena (Fischer) 1902, 3 Lief., 397–525 pp., 85 figs.

Kamen, L.—**Anleitung zur Durchführung bacteriologischer Untersuchungen für klinisch-diagnostische und hygienische Zwecke.**
Wien (Safar) 1903, 8vo, 311 pp., 118 figs., and 12 pls.

Mez, C.—**Mikroskopische Untersuchungen, vorgeschrieben vom Deutschen Arzneibuch. Leitfaden für das mikroskopisch-pharmakognostische Praktikum an Hochschulen und für den Selbstunterricht.**
Berlin (Springer) 1902, 8vo, 153 pp., 153 figs.

## Metallography, &c.

**Chemical Composition of Limestones. Microscopical Methods.***—E. A. Skeats in investigating the mineral character and the changes in the matrix of organisms in limestones, taken from certain upraised coral islands, often found it difficult to distinguish between aragonite and calcite, and occasionally between calcite and dolomite. For the former purpose he used Meigen's test which depends on the fact that when aragonite is boiled with a solution of cobalt nitrate it is coloured red, whereas calcite is unaffected. The author used the test in the following way : a polished slice of limestone, consisting of coral fragments, gastropods, echinid spines, Halimeda, &c., cemented with a large quantity

* Bull. Mus. Comp. Zool. Harvard Coll., xlii. (1903) pp. 65–9.

of fibrous calcium carbonate, was boiled for half an hour with cobalt nitrate solution. Afterwards the slice was mounted, polished side down, and ground down till transparent. It was found that the (*aragonite*) corals, gasteropods and Halimeda were stained red, while the (*calcite*) echinid spines were unaltered, as was also the cementing fibrous calcium carbonate.

There was seldom difficulty with calcite and dolomite, but in cases of doubt Lemberg's test was applied. This consists in treating the exposed surface of a thin section for 5–15 minutes with a solution containing a mixture of aluminium chloride and hæmatoxylin. Dolomite is unchanged, but a deposit of aluminium hydrate forms on calcite and stains reddish-purple. The staining solution is prepared by dissolving four parts of dry aluminium chloride in 60 parts of water and adding six parts of logwood. The whole is boiled and stirred for 25 minutes, and made up to original bulk. The author did not get good results if the stain remained on the rock for more than 15 minutes.

**Red Rain.***—F. Chapman and H. J. Grayson discuss the phenomenon of red rain with special reference to its occurrence in Victoria, and append a note on Melbourne dust. In two samples which fell at different times, they identified fragments of numerous minerals, diatoms, vegetable tissue and spores, sponge spicules, lorica of a rotifer, and various bacteria.

The Melbourne dust contained besides fragments of numerous minerals, cosmic dust, greenish-brown glassy spheres, and bits of rotifers and diatoms.

**New Etching Reagent for Polished Steel Sections.**†—F. N. Speller suggests the following method of developing the structure of iron and steel specimens. From 2 to 4 c.cm. concentrated nitric acid are slowly run into 100 c.cm. C. P. glycerin and the solution well mixed. After polishing and drying the specimen the surface is treated with a drop of C. P. glycerin, which is gently rubbed on the steel with the tip of the finger. A drop of the etching solution is now applied and friction with the finger continued until the surface is etched to the degree required. By fastening the specimen in a suitable holder the progress of the action of the acid may be followed through the Microscope and the development of the structure checked at the proper time by wiping the glycerin off with a soft cloth, and applying a drop of caustic soda-glycerin for a minute. The author states that the process works very well with low-carbon steels, the pearlite and granular structure being sharply defined, while the ferrite remains unstained even after 24 hours' continuous application of the etching solution. The chemical composition of this solution is not positively known, but it probably contains glyceric acid. It is found desirable to prepare a fresh solution every week and to keep in stock solutions of various strengths. The nitric acid used should not be fuming, otherwise nitroglycerin would be formed—a very dangerous substance.

**The Microscope in Crucible Steel Manufacture.**‡—J. J. Mahon points out that the Microscope, in order to be of any practical assistance

* Victorian Naturalist, xx. (1903) pp. 17–32 (2 pls.).
† Metallographist, vi. (1903) pp. 264–5. ‡ Tom. cit., pp. 195–6.

to the manufacture of fine steel, should be used on the ingot immediately after it is cast. It must be borne in mind that while good steel can be spoiled by bad treatment, bad steel cannot be converted into good steel by any kind of treatment except by remelting it. Hence the necessity for immediate examination.

**Simultaneous Presence of Ferrite and Cementite in Steel.***—E. F. Lange has arrived at the conclusion "that there can be no possible doubt, as Mr. Stead says, that structurally free cementite and ferrite may be obtained in the same steel. The conditions favourable to the formation of this structure are an extremely slow cooling between 700° and 600°." In a postscript, A. Sauveur admits the soundness of the conclusion.

**Effect of Superheated Steam upon the Tensile Strength of Alloys.**†—J. L. Hall has studied this subject with especial regard to alloys of copper, as experience has quite generally indicated that that metal and some of its alloys have proved unreliable when subjected to the action of highly superheated steam. His experiments point to the conclusion that the tensile strength of bronze is lessened after a first heating and cooling from 320° C., but that subsequent treatment of this nature had little effect upon the ultimate strength.

**Improved Method of Identifying Crystals in Rock Sections by use of Birefringence, and Improved Polarising Vertical Illuminator.**‡ J. Joly describes a method of observing on an ordinary rock-section the interference tints proper to double the thickness of the section, and of thereby producing discriminative effects not possible to obtain in the ordinary mode of observation. The method consists in placing a plane reflecting surface (polished speculum metal, preferably) beneath the rock-section as it rests on the stage of the Microscope, and transmitting, by means of any vertical illuminator (as used for the examination of metals, &c.), a plane polarised ray vertically downwards through the rock-section. The ray reflected from the speculum metal is again returned through the object-glass, and, after passing through the analyser, shows to the eye the retardation proper to double the thickness of section. In this manner the range of colour-variation from one species to another is greatly increased; in fact, what differences exist for the single thickness are now doubled in amount.

In this method a certain objection applied, in some degree, in all cases—a want of verticality in the downward directed ray, which involved necessarily that the section and its images in the reflector did not accurately overlie one another. In rocks of fairly coarse grain this did not signify; but in those of finer grain, an unpleasant overlapping of the colours of adjacent crystals occurred in the plane of incidence and reflection. In all the forms of the apparatus there was also required a separate polariser to polarise the beam entering the illuminator. The author has found that the simple vertical illuminator described in Messrs. Watson's catalogue gives very satisfactory results. The illu-

* Metallographist, vi. (1903) pp. 9–13 (1 fig.).
† Tom. cit., pp. 3–8 (5 figs.).
‡ Sci. Proc. Royal Dublin Soc., ix. (1901) pp. 485–94 (2 figs.); x. (1903) pp. 1–5 (1 fig.).

minator, consisting of a cover-glass contained within a collar, is inserted just above the object-glass, and is inclined so that rays entering an aperture in the front of the collar are, in part, reflected by the cover-glass (which can be rotated on a horizontal axis into the suitable inclination), and thence pass downward through the object-glass and illuminate the opaque object under examination. The rays finally reaching the eye (returning through the object-glass much the way they came) are for the most part transmitted through the transparent reflector. It was found that the quantity of light transmitted was sufficient, even without the use of a lens, to strengthen the beam; there was no appreciable parallax, and even small microlithic felspars in basalt could be seen, each glowing with its own colour and with sharp margins. A notable advantage is that, with this mode of illumination, the use of a polariser is unnecessary. When the source of light is elevated above the horizontal level of the aperture in the illuminator, so that the ray nearly reaches the glass at the polarising angle, the polarisation is very complete.

Barlow, A. E.—**Microscopic Examination of Sections of Rocks associated with the Iron-Ore Deposits of the Kingston and Pembroke Railway District.**
*Geological Survey of Canada, Ann. Rep.*, XII. (Ottawa, 1902) 8vo. Report I. Appendix A, pp. 81–91.

Campbell, E. D., & M. B. Kennedy—**Probable Existence of a new Carbide of Iron.**
[The authors give their reasons for the existence of $Fe_2C$, in addition to the well-known $Fe_3C$.] *Metallographist*, VI. (1903) pp. 139–47, 4 figs.

Chatelier, Le H., & M. Ziegler—**Sulphide of Iron: its Properties and its Conditions in Iron.** *Metallographist*, VI. (1903) pp. 19–38, 28 figs.

Dudley, P. H.—**Rolling and Structure of Steel Rails.**
*Metallographist*, VI. (1903) pp. 111–29, 14 figs.

Ewing, J. A., & J. C. W. Humfrey—**Fracture of Metals under repeated Alternations of Stress.**
*Phil. Trans.*, Nov. 20, 1902; and *Metallographist*, VI. (1903) pp. 96–110, 15 figs.

Guillet, L.—**Sur la Micrographie des Aciers au Nickel.**
[The author's experiments confirm the results obtained by L. Dumas in *Annales des Mines*, April 1902.]
*Comptes Rendus*, CXXXVI. (1903) pp. 227–8.

Howes, H. M.—**Iron, Steel, and other Alloys.**
*Metallographist*, VI. (1903) pp. 179–95, 6 figs.

Miers, H. A.—**Mineralogy, an Introduction to the Scientific Study of Minerals.**
[Described in the *Geological Magazine* for April 1903, p. 165, "as a really readable work, setting forth the principles of scientific mineralogy, and not unduly burdened with facts and technical details."]
London (Macmillian & Co.) 1902, xviii. and 584 pp., 2 cold. pls. and 716 illus.

**Nickel Steel.** *Metallographist*, VI. (1903) pp. 64–70, 6 figs.; and *Railroad Gazette*, Aug. 8, 1902.

Richards, M. A.—**Photomicroscopy of Metals as practised by Steel Companies.**
[Gives a useful account of methods in use.]
*Metallographist*, VI. (1903) pp. 71–80, 8 figs.

Sauveur, A.—**On the Industrial Importance of Metallography.**
*Journ. Franklin Inst.*, CLV. (1903) pp. 273–81.

Sauveur, A., & H. C. Boynton—**Note on the Influence of the Rate of Cooling on the Structure of Steel.** *Metallographist*, VI. (1903) pp. 148–55, 4 figs.

## MICROSCOPY.

### A. Instruments, Accessories, &c.*

#### (1) Stands.

**Leitz' Mineralogical Stand, No. I.**†—This stand is numbered 37 in the makers' series, and is shown in fig. 163. In its general dimensions it corresponds to the Leitz stand known as No. 1 A. The coarse adjustment is by rack-and-pinion, and the fine by a micrometer screw graduated into fifty divisions, a graduation signifying a movement of 0·01 mm. The condenser, iris diaphragm and polariser are raised and lowered by rack-and-pinion. Observation of the axial images is conveniently performed by means of a three-limbed condenser, which can, by means of lateral push-movement of the stop-carrier under the stage, be drawn out and replaced. The objective is centred on the rotation-centre of the rotatory object-stage, by means of a centring nose-piece. The stage itself is graduated into 360° with a vernier; it also bears graduations for orientating. The Nicol acting as a polariser can, after removal of the iris diaphragm from underneath, be itself drawn out. The 0°, 90°, 180°, 270° of this Nicol are marked. The analyser is set in a metal holder in a fixed position over the ocular, and the rim of the indicator is graduated into 360°. On the front of the tube is a flap which can be opened and closed, and through which the inner tube is accessible; in the inner tube there is a slit for the reception of a Bertrand lens. The function of this lens is to assist the ocular in magnifying the interference figures formed in the converging polarised light; lens and ocular are raised and lowered together, as desired, by means of rack-and-pinion. In the analyser there is a slit (45° to the zero) for films of selenite and Iceland spar. In many investigations it is recommended that, instead of the above, an analyser should be used inserted laterally into the tube. There is a revolver for three objectives.

**Leitz' Mineralogical Stand, No. II.**‡—The series-number of this instrument is 39 (fig. 164). The tube is carried by a brass foot and pillar, highly lacquered, and the adjustment is by rack-and-pinion. The rotatory stage is graduated on its circumference to 360°, and the reading is by a pointer. The polariser is set in a spring collar, whose zero and quadrant points are marked. The collar with the polariser is inserted in a holder which, by means of a lateral screw, can be raised and lowered or drawn aside. An illuminating lens is placed over the polariser in the stage, and by means of a lever can be turned out of the path of the

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Catalogue, No. 40, Nov. 1902, pp. 55–7. ‡ Tom. cit., pp. 58–9.

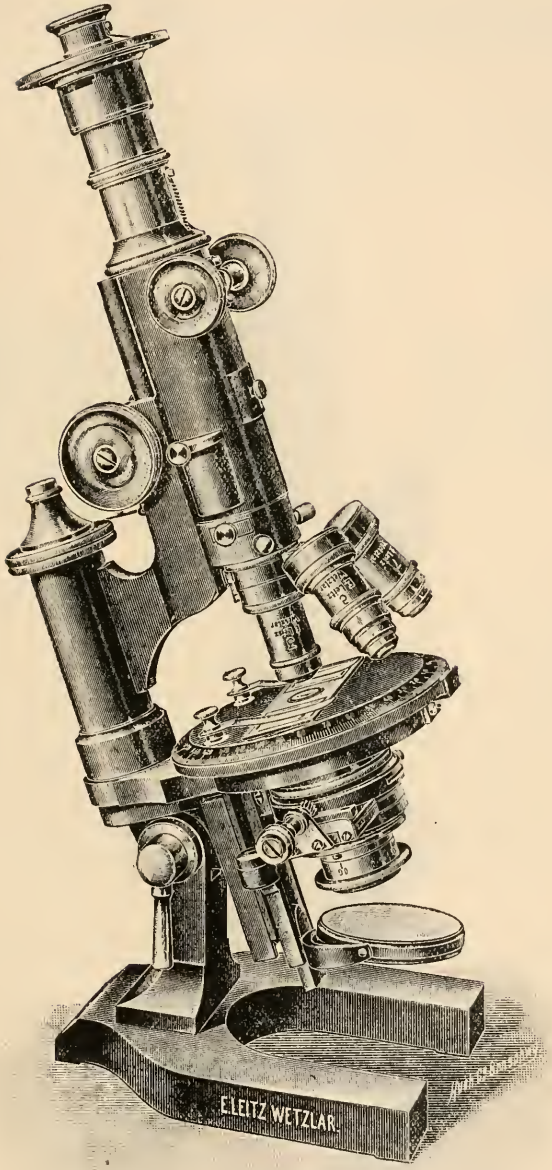



Fig. 163.

beam of rays when parallel polarised light is substituted for converging. The analyser is inserted in the optical axis in a broad slit in the tube over the objective, and is pushed in and out by a knob. Under the

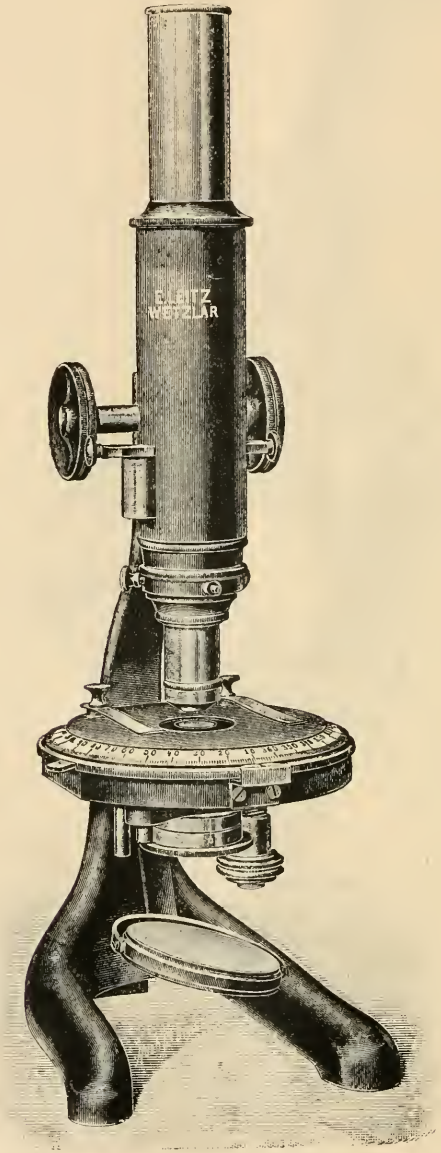



Fig. 161.

analyser is a slit for the selenite and quartz plates. The objective is centred on the rotation centre of the rotatory object-stage, by means of two centring screws acting on a centring nose-piece.

**Leitz' Handloups.***—The catalogue numbers of these are 69 and 70. The loups (figs. 165, 166) consist of two achromatic double lenses, producing a field very large, flat and free from tint. The magnifying powers are five and eight-fold, the corresponding diameters of the lenses being 30 and 23 mm., while the field of view measures 35 and 20 mm. respectively.

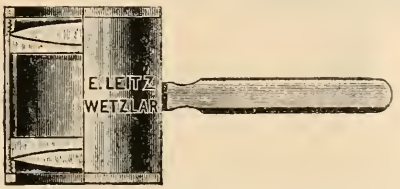



FIG. 165.

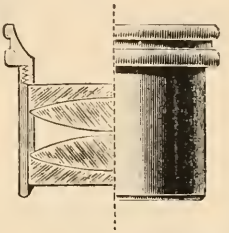


FIG. 166.

**Very Powerful Micrometric Microscope.**†—P. Boley finds that the "double Microscope," which he designed ‡ for observing the slightest displacement of the mercurial meniscus of the capillary electrometer, can be also used for ordinary purposes as a micrometric Microscope. In principle the Microscope is one in which the ordinary ocular is replaced by a true compound Microscope of large objective. It is formed of a tube double the usual length, with the principal objective at the anterior end, the objective of the ocular Microscope in the centre, and the actual ocular at the posterior end. The ocular-holder is tube-shaped and slides inside the main tube. The whole is fitted on a stand having three rectangular movements for controlling the field. The image obtained is erect, and the original magnification is increased from four to six-fold.

**Watson's "Argus" Attachable Mechanical Stage.**—This is a simplified form of mechanical stage, which can be readily attached by a single thumb-screw (fig. 167). The moving plates are not fitted in dovetailed grooves in the ordinary manner, but slide on guides, and are held in position and actuated by a frictional wheel made of brass and covered with indiarubber. This wheel is revolved by means of a milled head, which can be set in any position from the horizontal to the vertical, the movement taking place at right angles to its own direction.

The horizontal and vertical positions are indicated by spring catches, but between the two points a range of diagonal traverse is given when

* Catalogue, No. 40, Nov. 1902, p. 64.
† Trav. Sci. Univ. Rennes, i. (1902) pp. 340–2. ‡ Tom. cit., p. 277.

the milled head is operated. Being independent of racks and screws, no back-lash can occur. The range of motion is about $1\frac{1}{2}$ in.

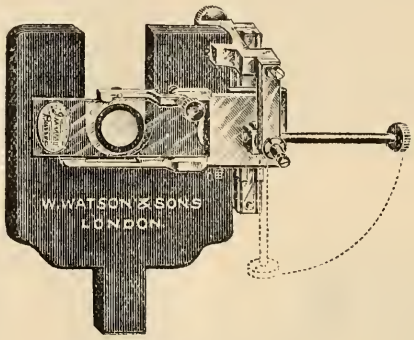



Fig. 167.

**A Lens Pseudoscope.***—The Wheatstone pseudoscope is composed of two totally reflecting prisms arranged with their edges perpendicular to the plane of vision. H. Bowden has arranged a pseudoscope in which he employs two pairs of identical convex lenses. He contrives a bar-frame like a capital H, the four lenses being set in sliding mounts on the outer lines. A handle in the middle of the cross-bar and perpendicular to the frame makes a good holder. One of the observer's eyes looks at an object through one pair of the lenses, and his other eye views it through the other pair. The planes of the lenses are so disposed that their foci coincide, and thus superimposed images are presented to the observer. It was found that the illusions produced were very complete, and had a superiority over the Wheatstone pseudoscope; but the images presented by it are inverted as well as transposed from right to left.

### (2) Eye-pieces and Objectives.

**Graphic Representation of the Correction Distance of an Objective.**†—H. Schmidt shows how, in the absence of the appropriate instrument, an idea of the astigmatism of a lens may be obtained. It is necessary to calculate, from the formulæ, the horizontal and vertical foci of oblique rays, and then to plot them to scale on paper. A curve should then be drawn free-hand through each set of foci. If these curves coincide the astigmatism will be nil; it will also vanish at points where they intersect: the amount of divergence on any ray will indicate the astigmatic difference for that ray. It may sometimes be desirable to plot on a magnified scale when the curves show close approximation.

**The Injurious Effect of Cement upon Objectives.**‡—G. Eberhard found that the zonal errors of certain telescope objectives markedly

* Trav. Sci. Univ. Rennes, i. (1902) pp. 157–163 (2 figs.).
† Central-Zeit. f. Opt. und Mech., xxiv. (1903) pp. 73–5 (3 figs.).
‡ Zeit. f. Instr., xxiii. (1903) pp. 274–7 (2 figs.).

varied with the temperature. He attributes this to changes in the Canada balsam cement, which seems to possess a hitherto unsuspected variability dependent perhaps on age as well as on temperature. Among other experiments he tested a certain camera objective before and after ten hours' heating at 60° C.; all the zonal errors were altered, one, e.g. rising from − 0·05 to + 0·56. In very important work, he concludes it would be best to use objectives free from cement.

EVERETT, J. D.—**On Skew Refraction through a Lens; and on the Hollow Pencil given by an Annulus of a very obliquely placed Lens.**
*Proc. Roy. Soc.*, LXXI. (1903) pp. 509–522 (2 plates).

SCHRŒDER, H.—**Ueber die Geschichte der Technik der Mikroskope.**
[Mainly an historical account of the evolution of modern lenses, interspersed with interesting anecdotes.]
*Central. Zeit. f. Opt. u. Mech.*, XXII. (1901) Nos. 19, 20, 21, 22.

### (3) Illuminating and other Apparatus.

**Tubeuf's Drawing Apparatus.*** — This apparatus (fig. 168) is intended for drawing objects from nature. By means of a prism an object is so reflected into the eye that its vertical projection on the drawing plane appears erect, a very desirable condition in nature-drawing. On the prism plane turned towards the object, smoked glasses of various

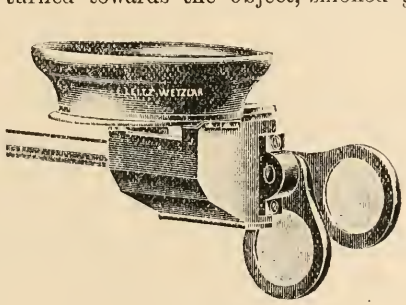


FIG. 168.

thicknesses can be applied for reducing the brightness of the object. On the prism plane towards the eye there is a small revolving disc, with small apertures for regulating the pupil opening. The prism can be set on a stand at various heights and widths.

**Fuess' Hemispherical Gypsum and Metal Reflectors.†** — These reflectors, numbered 8 in the maker's catalogue, are intended to be placed on the Microscope stage over an opaque object of very small dimensions. The arrangement is shown in fig. 169. The light coming from the mirror reaches the white spherical interior of the gypsum, and is thus completely reflected in all directions; the object being thereby completely and uniformly illuminated without shadows. An opening

* Leitz' Catalogue, No. 40, Nov. 1902, p. 74; Centralb. f. Bakt., 1899, pp. 765–6.
† Fuess, Special-Liste, No. 74, pp. 4 and 5.

in the top facilitates adjustment and transmission of the image. The reflector is made in two sizes, whose diameters are 30 mm. and 50 mm.

Exactly similar reflectors are also made out of metal.

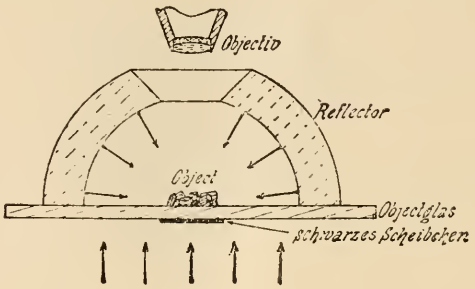



Fig. 169.

The same firm also supply round object-slides of white mirror-glass, with a metal plate cemented on to the centre; the effect is to give a completely black underground.

#### (4) Photomicrography.

**Photography by Natural Lenses.*** — W. F. Watson has used the crystalline lens from a bullock's eye for photography. A lens-holder was constructed out of a small cardboard pill-box, with a perforated ledge inside for the reception of the eye. The lid and floor of the box are pierced with circular holes smaller than the lens, and it was found necessary to keep its surface moistened with a brush. The lens must be so placed that the flatter surface is underneath and the rounder one uppermost; and, when once arranged, it must, if possible, not be touched, owing to its delicate nature. The object to be photographed was illuminated with natural light in the ordinary way. It was found an improvement to enclose the crystalline lens, fresh from the animal's eye, between two large watch-glasses of suitable curvature and true shape, their inner surfaces being moistened. These lenses were then completely covered with blackened gummed paper, with the exception of the small circular openings in the middle of the convex surfaces. The lens so prepared could then be applied to the camera.

The author has also used the eye-lens of a fly for photographic purposes, and has reproduced the well-known multiple images. He gives specimens of his success.

Marktanner-Turneretscher, G.—**Wichtigere Forschritte auf dem Gebiete der Mikrophotographie und des projektionswesens.**

[Gives a comprehensive résumé of international progress in these departments of science.] *S.A. Jahrb. f. Photographie und Reproduktionstechnik f.*, Halle, 1903, 10 pp.

* Scientific American, quoted in Central-Zeit. f. Opt. und Mech., xxiv. (1903) pp. 144–6 (7 figs.).

### (5) Microscopical Optics and Manipulation.

**Drude's Theory of Optics.***—This important work has been translated from the German into English by C. R. Mann and R. A. Millikan. The preface to the English translation has been written by Prof. Michelson, who states that there is no other book in English which embodies the important advances in both theory and experiment made during the last decade. It excels in presenting a complete development of the electromagnetic theory of light in all its bearings, and a comprehensive discussion of the relations between the laws of radiation and the principles of thermodynamics.

The book consists of three parts, respectively devoted to: (i) Geometrical Optics, (ii) Physical Optics, and (iii) Radiation.

Part i. is on the usual lines, and follows closely Czapski's treatment in Winkelmann's *Handbuch der Physik*.

Part ii. is subdivided into two parts: general properties of light, and optical properties of bodies. This part includes, as an important advance upon most previous textbooks, Sommerfeld's rigorous solution of the simplest case of diffraction, Cornu's geometric representation of Fresnel's integrals, and, on the experimental side, Michelson's echelon spectroscope. It also extends the hypothesis as to the nature of light. The mechanical theories are merely mentioned, but the electromagnetic theory, which the author considers to present the simplest and most consistent treatment of optical relations, he has discussed at length.

Part iii. is concerned with the relation of optics to thermodynamics, and (in the third chapter) to the kinetic theory of gases.

**Numerical Aperture and Rapidity.**†—W. A. E. Conrady in a paper on this subject remarks, that whereas Microscope lenses are classified by their N.A., photographic lenses are by their *f*-values, i.e. *f*/8, *f*/16, &c. Formulæ are given: first, to express the N.A. of a Microscope-lens in terms of photographic *f*-value; secondly, for converting photographic *f*-values into N.A.

I. $$f\text{-value} = \frac{m}{2\ \text{N.A.}}.$$

II. $$\text{N.A.} = \frac{m}{2\ (m+1) \times f\text{-value}}.$$

N.A. is numerical aperture, and $m$ magnifying power.

**Specific Double Refraction of Plant Tissues.**‡—B. Remec, after many experiments, concludes: (1) That lignin has no influence on the specific double refraction of plant tissue; (2) that even in cell-walls of similar thickness and similar chemical composition, the degree of double refraction may vary according to peculiarity of organisation; (3) that if pores exist in the cell-wall, the greatest optical axis of elasticity of Fresnel's ellipsoid lies in the direction of the pores; (4) the membranes of superposed tissues generally produce elliptic polarisation, the main axis being sometimes parallel, sometimes perpendicular to the anatomical

* Longmans, Green & Co., London, 1902, 546 pp. (110 figs.).
† Knowledge, xxvi. No. 216 (1903) p. 236.
‡ S.B. Akad. Wiss. Wien., pp. 364–87 (3 figs.).

cell-axis ; (5) that it is possible in many cases of equal chemical composition and equal morphological formation to distinguish histological elements from one another in polarised light.

**Visual Purple.*** — J. Von Kries considers that visual purple is a substance which supplies the retinal basis for vision at low luminosities, and the accumulation of this substance is accountable for the great increase in sensitiveness of the dark-adapted eye—a thousand-fold increase according to some computations.

**Some Experiments with Actinic Light.**†—J. W. Kime, with the object of furthering the application of coloured light in therapic treatment, has conducted some experiments for the purpose of localising those bands in the solar spectrum which are rich or poor in actinic rays. Strips of glass, corresponding in colour to the various tints of the solar spectrum, were placed in a frame, bound to a sensitised plate, and exposed almost instantaneously to very weak diffused daylight, which entered the dark room without passing through glass. The result is shown in fig. 1, plate VIII., which is a negative plate. The open space and the plain glass strip, which were also provided, when compared with the blue glass present very little difference, the plain glass being a shade darker, showing that less actinic light passed through it than through the other two. It was found that no light whatever reached the plate through the red, and no trace is apparent in the orange ; the yellow transmits an appreciable amount ; and the green just enough to be seen. From this point we jump from almost zero in the green to 100 p.c. in the blue. Hence wave-length has nothing to do with determining the chemical activity of the light. In the indigo there is a slight diminution from the blue, but there is still fully as much as traversed the plain glass. In the violet we drop back to about the same percentage as in the yellow. It is apparent from the photographs that colour, independently of wave-length, influences the chemical action of light. Fig. 2, plate VIII., which is a positive, is in every sense confirmatory of the conclusions drawn from fig. 1, but was produced in a directly opposite manner. The same strips of glass as before were again used, but were placed over ordinary photographic printing paper, Aristo, and were exposed to the sun until the open space was fully printed. No other glass intervened between the sensitised paper and the sun except the strips referred to. Experiments were also made to test the penetrability of actinic light through the tissues of the human body.

KRÜSS, H. A.—**Die Durchlässigkeit einer Anzahl Jenaer optischer Gläser für ultraviolette Strahlen.** *Zeit. f. Instrumentenkunde*, XXIII. (1903) pp. 197–207, 4 figs (July); and pp. 229–239, 3 figs. (August).

SIEDENTOPF, H., & R. ZSIGMONDY—**Über Sichtbarmachung und Grössenbestimmung ultramikroskopischer Teilchen, mit besorderer Anwendung auf Goldrubingläser.**

[The substance of this pamphlet was given to the Society at the Meeting on June 17, 1903, and is reported in the Proceedings for that date.]

*S.A. Physik. Vierte Folge.* X. (1903) 39 pp.

A copious French abstract of the preceding appears in the *Bibliothèque Universelle* (*Arch. Sci. Phys. et Nat.*), XVI., Geneva, 1903, pp. 130–8.

* Abhandl. z. Physiol. d. Gesichtsempfindungen, 1897, pp. vi. and 198; 1902 p. 197. Leipzig.

† Scientific American, quoted in English Mechanic, lxxviii. (1903) pp. 478–9 (3 figs.).

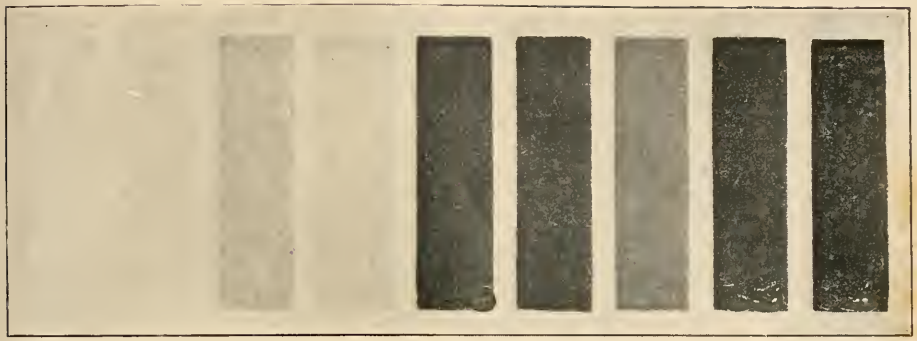


Fig. 1.

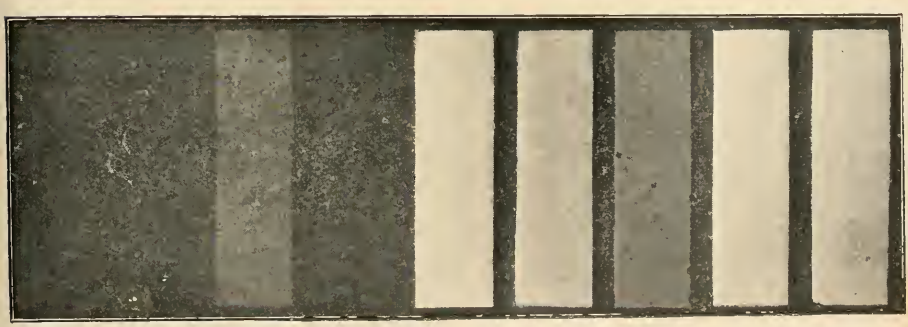


Fig. 2.

Experiments with Actinic Light.

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Method of Preparing Sugar-free Bouillon.**†—F. E. Montgomery has found that if meat infusion be sterilised previous to the inoculation with the colon bacillus, an odorless sugar-free broth is obtained. The method is as follows : To a portion of the fat-free beef, ground fine, add double its weight of cold water, and bring slowly to a temperature of 50° over water bath. Keep at this temperature for three hours, then strain through muslin. Steam sterilise the infusion for three-quarters of an hour. Allow to stand overnight in an ice-box, and then inoculate with *B. coli communis*. Incubate at 37·5° for 18 to 24 hours, then boil and filter. Next add ½ p.c. NaCl and ¼ p.c. peptone, and boil for three-quarters of an hour. Neutralise with NaHO, filter and sterilise.

**Cultivation Medium for Algæ.**‡—G. T. Moore finds that for general purposes a modification of Beijerinek's medium is very satisfactory. This consists of ammonium nitrate, 0·5 grm. ; potassium phosphate, 0·2 grm. ; magnesium sulphate, 0·2 grm. ; calcium chloride, 0·1 grm. ; distilled water, 1000 c.cm. ; iron sulphate, a trace.

For blue-green Algæ, the amount of ammonium nitrate should be doubled, and the addition of from 1–2 p.c. glucose is often of benefit. This solution may be used with silica jelly, though ½–1 p.c. of agar hardens it sufficiently for general purposes.

**Demonstration of Tubercle Bacilli in Sputum.**§—A. Nebel advises that the sputum be well shaken up with 8–10 times its volume of lime water. This renders it apparently homogeneous, and it is then centrifuged for 2 minutes. The supernatant fluid is passed through a Berksfeld filter ; and the deposit remaining on the filter removed, mixed with a drop of water, and examined in the usual way.

The author found that after centrifuging, the sediment did not contain more bacilli than fell to its lot on account of its weight and volume.

**New Method of Isolating B. icteroides.**‖—J. Bandi makes use of the agglutinating power of anti-amaryllic serum as a means of separating *B. icteroides* (Sanarelli) from other organisms. He first determines accurately the specific agglutinating doses of the serum, both for the bacillus in question and for the organisms found most frequently in symbiosis with it. Serum is then added, in the former proportion, to a (7 p.c.) gelatin nutrient medium contained in tubes drawn out to a closed funnel-shaped point at the lower end. The tubes are then superficially inoculated with the material to be examined and incubated

* This subdivision contains (1) Collecting Objects, including Culture Processes ; (2) Preparing Objects ; (3) Cutting, including Imbedding and Microtomes ; (4) Staining and Injecting ; (5) Mounting, including slides, preservative fluids, &c. ; (6) Miscellaneous.

† Journ. App. Micr., vi. (1903) p. 2409. ‡ Tom. cit., pp. 2309–14.

§ Arch. f. Hyg., xlvii. (1903) p. 57. See Centralbl Bakt. Ref., xxxiii. (1903) pp. 665–6. ‖ Centralbl. Bakt. Orig., 1te Abt., xxxiv. (1903) pp. 463–79.

at 37° C. After 10–12 hours the *B. icteroides* will be seen to have settled in the lower part of the tube, in flocculent agglutinated masses. The culture is then cooled down and the gelatin allowed to set. The pointed end of the tube is then broken off, and some of the flocculi removed with a platinum needle, isolation being effected by this means. If the culture is mixed with organisms which naturally fall in masses to the bottom of the culture medium, e.g. streptococci and the proteus varieties, then, the pointed end of the tube having been broken off, its contents are poured in a very thin layer into a Petri dish, and the masses picked out by means of their characteristic appearance under the microscope.

**Tubes for the Preparation of Aërobic and Anaërobic Cultures under the Influence of Coloured Rays.***—E. Bartarelli. The apparatus (fig. 170) is made of two large test-tubes. One, measuring 25 cm. in length and 3·5 cm. in diameter, has a small cylindrical tube blown in its lower end. The other, about 1 cm. shorter than the first and 2·8 cm. in diameter, has near its lower end three indentations. The lesser is placed inside the larger and their edges fused together. The space between the two tubes is now filled with a coloured solution through the hole in the outer, which is then corked. A monochromatic chamber is then produced in the inner tube. In this chamber the culture tube is placed. If anaërobic conditions are required the inner tube may be used à la Buchner.

Fig. 170.

**Rapid Method of Hardening and Imbedding Tissues.**† B. M. Bolton and D. L. Harris found that tissues can be readily hardened and imbedded for cutting into sections in a hot solution of agar and formalin. Nine parts of a 5 p.c. aqueous solution of agar are mixed with 1 part of formalin. The agar is boiled, for several hours, and after the addition of the formalin allowed to clear by sedimentation. The bits of tissue are placed in a wide test tube containing some previously melted mixture. This is kept at 60°–70° C. for an hour or longer, and the tissue then blocked, after which it is immersed in strong or absolute alcohol for an hour or so, when it is ready to be cut. The whole process does not exceed 3 to 4 hours, when the pieces are not more than 1 cm. in diameter.

**Preparation of Diatoms.**‡—F. J. Keeley calls attention to the following method for studying the structure of diatoms. This consists in depositing on the diatoms a thin film of silver, using the solution ordinarily employed for silvering mirrors, which, dropped on the cover glass containing the diatoms, will silver the latter to a considerable extent before any appreciable quantity of the metal is deposited on the

* Centralbl. Bakt., 2te Abt., x. No. 22–3 (1903) pp. 739–40.
† Journ. App. Micr., vi. (1903) p. 2414.
‡ Proc. Amer. Nat. Sci. Philadelphia, lv. (1903) pp. 2–3.

glass. The preparations are mounted in balsam and inspected by transmitted light. This process differs from that by which A. Y. Moore plated diatoms, his being covered with a heavy layer of silver or gold and examined as opaque objects. It is rather a staining process, rendering the silica opaque or nearly so, and thus differs from other methods which fill the cavities in the valves with opaque matter. The results so far have been principally corroborative of previous observations, but many features are rendered not only more obvious but new characteristics brought to light, among which may be mentioned a ring of processes near the margin of the valve of *Coscinodiscus subtilis* which extends towards the interior of the frustule. In *Navicula* and its allies the raphe is well displayed, and in *N. rhomboides* the raphe is shown to be single.

**Fixation of the Mammalian Egg in the Uterine Cavity.***—H. Schoenfeld excised the gravid uterus of rabbits at intervals of 6 to 10 days after impregnation. The organ was placed for $\frac{1}{4}$–$\frac{1}{2}$ an hour in $\frac{1}{2}$ p.c. chromic acid, in order to coagulate the blood in the vessels, and then cut up into small pieces. These were placed in some fixative solution, the best results being obtained from Hermann's fluid. Flemming's fluid was next best, while sublimate and Zenker's medium were much less efficacious. The sections fixed in fluids containing osmic acid were stained with safranin and picric acid, safranin and light green, or with Heidenhain's iron hæmatoxylin. The sublimate or Zenker sections were stained with Delafield's hæmatoxylin followed by eosin, or by van Gieson's method of iron hæmatoxylin.

**Improvements of Aubertin's Method for Sticking on Celloidin Sections.**†—F. Müller describes the following modification of Aubertin's method for making celloidin sections adhere to the slide, which procedure consisted in running a mixture of ether and alcohol over the section. The author first puts a thin film of glycerin-albumen on the slide, and warms it over the flame as long as it vaporises. The section is then floated in 95 p.c. alcohol on to the film, and as much of the alcohol as possible removed with blotting-paper. Henceforward the slide must be kept in the horizontal position. When the section begins to look opaque, a few drops of a mixture of equal parts of alcohol and ether are pipetted over. The slide is then left for 5–10 minutes, in which time the ether-alcohol will have evaporated. The slide is then treated for a short while with 70 p.c. alcohol, and afterwards for a longer time with water. The section is then cleared up with carbol-xylol, and may then be stained, or if so desired may be kept for a while. In the latter case it is advisable to immerse the slides for 5–10 minutes in 95 p.c. alcohol, in order to soften the celloidin a little.

**Preparing Sections of Cancellous Bone.**‡—E. O. Little sticks the rough section of bone or tooth on the slide with xylol-balsam. The balsam is then ignited and allowed to burn as long as possible, care

* Archiv. Biol., xix. (1903) pp. 701–828 (4 pls.).
† Centralbl. Allgm. Pathol. u. pathol. Anat., xiv. (1903) pp. 671–2.
‡ Journ. App. Micr., vi. (1903) p. 2254 (1 fig.).

being taken not to injure the section. The flame is then extinguished, and the section pressed firmly to the slide until the balsam hardens. The free side may then be ground down on a whetstone to any desired thickness.

**Contributions to the Theory of Fixation, with Particular Regard to the Cell-Nucleus and its Albuminous Bodies.***—W. Berg in an important paper gives the results of his experiments on the individual effects of 24 fixing agents on nucleïns and nucleic acids from various sources, and on other bodies, such as clupeïn—a representation of the protamines—both by itself, as a sulphate, and in combination with nucleic acid. Although sometimes larger quantities were used, a drop of a filtered solution was usually taken—generally in 2 p.c. KOH—of the proteid substance, and mixed with one or more drops of the fixing agent on an ordinary microscopic slide. The effect was then observed as regards (1) the presence or absence of precipitate, (2) its water-solubility, and (3) the forms taken by it. The last the author groups into (*a*) coagula and granular films, (*b*) granules, and (*c*) hollow bodies. He does not claim that the results of his experiments constitute a reliable index to the effects of fixing agents on tissues or on cells, the proteids existing in them not being identical with those of the solutions experimented on. Moreover, the behaviour of the representative of a group of bodies such as the nucleic acids is not constant, but varies with the origin of the substance. For example, acetic acid causes no precipitate with nucleic acid from soft roe of the herring, but with that derived from yeast there is a marked precipitate. Neither are the results with clupeïn constant with protamines in general. Space will not permit even a résumé of the experimental results. The apparent lack of effect of formalin is however striking. The 33 p.c. alcoholic solution of sublimate is much superior to the 7·5 p.c. aqueous solution. Osmic acid precipitates neither nucleïns nor nucleic acids, while alcohol, acetic acid and, above all, chloroform-alcohol-acetic acid have the strongest effect on them.

### (3) Cutting, including Imbedding and Microtomes.

**Manipulation of Sections of Leaf Cuticle.**†—S. M. Bain takes a very narrow strip of the leaf and embeds it in paraffin. The paraffin is trimmed away under a lens until the surface to be cut is reduced to a minimum. The sections, cut off in scrolls, are placed on a small drop of distilled water on the centre of a slide. Here they usually unroll of their own accord; if not, slightly warming may flatten them out. The water on the slide is allowed to evaporate spontaneously, and when dry the slide is warmed until the paraffin just begins to melt. The rest of the procedure is similar to that usually followed.

**Imbedding in Celloidin.***—C. H. Miller recommends the following method. Into the wide mouthed cork-stoppered bottles are placed solutions of celloidin of graduated strength, each 100 c.cm. containing

* Arch. Mikr. Anat., lxii. (1903) pp. 367–430.
† Journ. App. Mikr., vi. (1903) pp. 2160–1. * Tom. cit., pp. 2253–4.

2, 4, 6, &c., up to 20 grms. by weight of celloidin. The dehydrated tissue is placed successively in the ten bottles for 24 hours. If it is to be cut immediately, the tissue is mounted on a block and hardened in chloroform for 15 to 20 minutes, or in 80 p.c. alcohol for several hours. If it is to be kept for some time, the piece is removed from the 20 p.c. solution with a thick layer of celloidin surrounding it and dropped into chloroform to harden it, after which it is kept in a solution composed of equal parts of 95 p.c. of alcohol and glycerin. When wanted for cutting, the tissue is wiped dry with a clean cloth, a thin layer of celloidin is shaved off, and the piece immersed in 6 p.c. celloidin for several minutes ; then mounted on a block and hardened in chloroform. The only inconvenience attached to this method is that it takes 12 days at least, but its many advantages amply compensate for the extra time and trouble.

**Use of Paraffin Imbedding for Medullary Sheath Staining.*** G. L. Streeter bases the method he advocates on the supposition that the failure of Weigert's method with paraffin sections is due to the solvent action of xylol on the myelin during the process of imbedding. He stains the tissue in bulk with Weigert's hæmatoxylin, after it has been passed through Müller, or some other chromic solution, and 80 p.c. alcohol. He then brings it into paraffin, melting at 50° C., through 70 p.c. alcohol, absolute alcohol and xylol. Sections are cut and fixed on the slide in the usual way, and brought into water through xyol and alcohol. They are then ready for differentiation, which can be accomplished either by Weigert's solution of potassium ferricyanide and borax, which the author uses diluted ten times, or by the modification of Pal.

**New Method for the Preparation of Horizontal Sections of Thin Laminated Vegetable Flat Tissues.**—P. F. Reinsch † recommends the following method. The substance is first macerated either in water or in some caustic solution, e.g. KOH or $H_2SO_4$. After this it is washed and lifted out on a glass plate. If a caustic solution has been used this is first neutralised with $NH_3$ or HCl. During the maceration a good deal of gum is probably developed, and by this the substance, as it dries, sticks of itself to the glass plate. If not, then gum or a transparent alcoholic solution of resin must be used, care being taken to avoid flatness and the inclusion of air bubbles. The next step is the separation of horizontal layers as desired, and this is accomplished by carefully damping the flat surface of the object firmly adhering to the glass plate, not its edges, and separating the topmost layer by means of a special microscopic scalpel, which the author makes himself in three shapes out of ordinary medium-sized needles, grinding the half towards the eye end to form a cutting edge, and mounting on holders. He uses this method for such delicate objects as flower petals.

MINOT, C. S.—**History of the Microtome.** Parts I. and II.
*Journ. App. Micr.*, VI. (1903) pp. 2157-60, 3 figs., pp. 2226-8, 1 fig.

* Arch. Mikr. Anat., lxii. (1903) pp. 734-9.
† Zeitschr. Wiss. Mikr., xx. (1903) pp. 28-33.

### (4) Staining and Injecting.

**Method of Staining Sputum for Bacteriological Examination.**—W. H. Smith * recommends the following method. Make and fix films in the usual way; stain with anilin-gentian-violet, and warm until steam rises; wash with potassium iodide solution (Gram's), and again warm; decolorise with 95 p.c. alcohol; treat for a few seconds with alcohol and ether (4 : 6), and warm with water; stain for one second with saturated watered solution of eosin; wash surplus away with Löffler's blue, and again warm; decolorise with 95 p.c. alcohol, and thus bring into Canada balsam through absolute alcohol and xylol. Leucocytes, lymphocytes, as well as red blood corpuscles, stain with eosin; whilst the cell nuclei take Löffler's blue. Bacteria positive to Gram stain deep violet or black; whilst those negative to Gram are blue. Bacteria with capsules have the latter tinted with eosin.

**Two Botanical Staining Methods.**†—A. V. Tompa recommends the following:

1. *The Saffron, Prussian-blue and Alcanna Method.*—This depends on the fact that if sections of vegetable tissue are treated with perchloride of iron and ferrocyanide of potassium, in succession, a precipitation of Prussian-blue takes place in the cell-walls. This precipitation occurs only in unthickened cell-walls, and not in vascular bundles, sclerenchyma, cuticular or cork tissue. It is therefore differential as regards the former. If the sections are first treated with tincture of saffron, the woody- and bast-fibres take on a bright yellow colour, and the after use of tincture of alcanna produces a red staining of the cuticular and cork tissue. An important preliminary condition is that the material should have been for some time previously in alcohol, for the removal of the tannic acid, thus avoiding the inky combination of the substance with the perchloride. The author suggests that sections from fresh material should be kept for two days in 96 p.c. alcohol. The steps of the method are these: the sections are placed in tincture of saffron for 48 hours and are then washed in distilled water; they are then placed in a ·25 p.c. solution of perchloride of iron for 15–30 seconds, washed for a short time in distilled water, and treated with a ·5 p.c. watery solution of ferrocyanide of potassium for 10–20 seconds. The sections are then again washed in water acidified with HCl and in water alone; and lastly are immersed for one second in a hot, watery solution of alcanna. They are then, after a final washing, mounted in glycerin jelly or taken through alcohol and chloroform into Canada balsam.

2. *The Gold Method.*—This depends on the formation of "purple of Cassius," when gold chloride is added to a solution of stannous chloride. Sections from alcohol material are placed in a weak solution of stannous chloride for 24 hours; they are washed in distilled water acidified with HCl, and then immersed for 10–30 seconds in a ·1 p.c. watery solution of gold chloride, also acidified with HCl, which it is of advan-

* Boston Med. and Surg. Journ., 1903, pp. 659–69. See also Zeit. Wiss. Mikr., xx. (1903) pp. 88–9.

† Zeit. Wiss. Mikr., xx. i. (1903) pp. 24–8.

tage to warm to 25° C. The sections are washed in acidified water, and then kept for at least 24 hours in a 50 p.c. watery solution of glycerin. They are then brought into Canada balsam through alcohol and chloroform. This method differentiates non-woody cells, as those of the bast-parenchyma and medullary tissue.

**Vital Staining of Micro-organisms.**—B. Romanoff* has studied granules in bacteria, moulds and yeasts, by means of vital staining with methylene-blue and neutral red. The property of the latter to lose its colour in the presence of alkalies, and to regain it with acids, makes this stain a delicate indicator of the reaction of the cytoplasm in different parts of the same cell. He finds that in yeast there are granules other than fat and glycogen staining with neutral red. To demonstrate this he grew it in a medium poor in nutrient elements, containing mag. sulph.; pot. phosph.; sod. chlorid.; asparagin; peptone. Yeast so cultivated contained no glycogen and a minimum of fat.

**Vital Staining of Blood-Plates in Man with "Brillantkresyl-blau."**—G. Puchberger† stains blood-plates with this dye in less than a minute, and, after the lapse of about a quarter of a hour, a hyaline substance separates itself in spherical form (Hyalomer), but continues connected by a constriction with the remaining, also circular, stained part of the cell (Chromomer). The nuclei of the lymphocytes and the granules of the leucocytes stain in a similar manner, but not so the nuclei of the polynuclear or the large mononuclear cells. In leukæmia are found large blood-plates the size of lymphocytes. These behave in the above described manner. Similar changes occur in lymphocytes, the nuclei of which separate from the protoplasm. The statement that the chromomer of blood-plates corresponds to the nucleus requires proof.

**Iron Carmalum.**‡—J. G. de Groot suggests the following as a useful modification of Mayer's Carmalum. (1) Carminic acid (F. A. Kahlbaum, Berlin So.), 1 grm.; (2) ammonio-sulphate of iron, ·1 grm.; (3) alum, 5 grm.; and (4) distilled water, 200 c.cm. To prepare the stain, dissolve No. 1 with warmth in 20 c.cm. water; add No. 2 and dissolve; add 180 c.cm. water and warm; stir in No. 3; cool and filter; add two drops hydrochloric acid, and a crystal of thymol.

It can be used both for bulk staining and for sections.

**Modification of the Uranium Carmine Staining of Schmaus.**—E. Chilesotti§ has devised the following method for staining axis cylinder with carmine. 1 grm. soda carmine (Grübler) is rubbed up with ·5 grm. uranium nitrate. The mixture is boiled for half an hour with 100 c.cm. water, then filtered, and before use a little 1 p.c. hydrochloric acid alcohol is added to the solution (·5–1 c.cm.). Sections hardened in Müller stain in this in 5–10 minutes, those hardened in formalin in 15–20 minutes, in Weigert's neuroglia mordant in 30–60 minutes, and

* Bull. Soc. Imp. Natur. Moscow, 1903. pp. 581–2.

† Virchow's Archiv., 1903, Heft 2. See Centralbl. Bakt. Ref., xxxiii. (1903) p. 545.

‡ Zeit. Wiss. Mikr., xx. (1903) pp. 21–3.

§ Centralbl. Allg. Path., 1902, p. 193. See also Zeit. Wiss. Mikr., xx. (1903) pp. 87–88.

Marchi sections in 2–4 hours. Sections are then washed in water, alcohol and carbol-xylol. If overstaining has taken place, or if the celloidin is also stained, the sections should be immersed in ·5–1 p.c. hydrochloric acid alcohol. This method can be employed with frozen, paraffin or celloidin sections.

**Thermophore for use in Staining.**—A. Hinterberger * describes a thermophore suitable for methods in which it is desirable to use the staining solutions for periods of time. It consists of a box like a Petri dish, 9 cm. in diameter and 4 cm. high. The lid has on its upper surface a cup-shaped depression for holding the stain. The heat is obtained by first filling the box with sodium acetate or barium hydrate, and then adding cold distilled water. The uncovered dish will maintain for an hour a temperature of from 44° C. to 41° C., or from 54° C. to 51° C. respectively. In the covered dish the cold water poured in soon becomes warm, and the temperature then sinks in about an hour and a half from about 49° C. to 43° C., or from 60° C. to 42° C. respectively. The thermophore, filled with sodium acetate, ought to lie before use for seven minutes in boiling water. If barium hydrate is used the longer it is kept in boiling water the longer it will keep warm.

### (5) Mounting, including Slides, Preservative Fluids, &c.

**Soluble Glass as Mounting Medium for Examination of Paper.**† C. E. M. Fischer recommends soluble glass for mounting specimens of paper fibres. The paper is first softened in warm distilled water and then reduced to pulp. A piece is then teased out on a slide, and, after the surplus water has been removed, the slide is then held over the flame until just sufficient moisture remains to wet the preparation evenly. A drop of thick soluble glass is placed on the fibres, and then a cover-glass over all. The only inconvenience of this method is frequency of air bubbles, but in other respects it is extremely advantageous.

### (6) Miscellaneous.

**Microscopical Examination of Paper.**‡—J. Hübner states that it is often of importance to ascertain microscopically the kind or kinds of fibres from which a paper has been made. Pieces of the paper to be examined, taken from various parts of the sheet, are boiled for 10–15 minutes in a weak solution of caustic soda (1 p.c.). The boiled paper is now placed on a fine sieve, washed free from soda. It is then transferred to a bottle containing garnets, and after a short shaking with water, the pulp is drained and is then ready for examination. The principal reagents required are iodopotassic iodide solution and iodozinc chloride solution. The former turns linen, cotton and hemp, light to dark brown; straw and jute cellulose, grey; wood cellulose and esparto, partly grey, partly brown; manila hemp, partly grey, partly brown, partly yellowish brown; wood pulp and raw jute, partly yellow, partly yellowish brown.

* Zeit. Wiss. Mikr., xx. (1903) pp. 14–16.
† Journ. App. Micr., vi. (1903) p. 2413.
‡ Journ. Soc. Arts, li. (1903) pp. 872–3.

Zinc chloride solution gives the following reactions: Cotton, linen and hemp, claret-red; wood, straw, esparto and jute cellulose, partly blue, partly reddish and blueish violet; manila hemp, blue, blueish violet, dull yellow and greenish yellow; wood pulp and raw jute, lemon to dark yellow. Before applying zinc chloride solution, the pulp must be freed from water by squeezing it on a porous plate. The fibres are then teased out with platinum needles and covered with a thin cover-glass.

The structural characters of the different fibres when inspected under the Microscope are as follows. Cotton fibres appear as flat ribands, usually twisted on themselves. The flax fibre is round and fairly regular, and shows a narrow central canal with numerous dark cross-lines, and the characteristic linen bulbs. Hemp fibres cannot be distinguished from flax fibres. Mechanical wood has a ragged or torn appearance, and its structure is not fibrous. It also shows pitted vessels or pores and cross-markings on many of the cells. The bast fibres of jute are distinguished by a canal, the width of which varies considerably. Wood cellulose fibres are usually flat, often twisted, and not unlike cotton; not infrequently pitted pores are visible. Straw fibres are round and smooth, and accompanied by numerous cuticular cells, some of which are very wide and flat, whilst others are peculiarly marked and serrated. The spiral-shaped cells carry a ring at each end. Esparto fibres and cells are very similar in appearance to straw fibres and cells. The characteristic pear-shaped hairs or cells are, however, always present, and afford a ready means of distinguishing esparto from grass.

**Detection of Trypanosomes.*** — As Trypanosomes are not present in large numbers it is necessary, says A. Castellani, to draw off at least 15 c.cm. of cerebrospinal fluid. It is better to reject the first few cubic centimetres as they are apt to contain blood. When the fluid comes away clear, 10 c.cm. are collected and centrifuged for 15 minutes. The deposit is slight. The sediment, which is whitish, is examined under a moderately low power, and as the trypanosomes are at first fairly active they are easily detected.

D. Bruce and D. Nabarro adopt the same method as the foregoing for examining the cerebrospinal fluid obtained by lumbar puncture. In the case of blood, they found that the presence of the corpuscles was a barrier to detecting the parasites, and it is a curious fact that both filariæ and trypanosomes resist the centrifugal action, and are most readily found after being centrifuged three or even four times. The procedure adopted was to collect 10 c.cm. of blood from a vein, in a test-tube containing a little citrate of potash solution to prevent coagulation. After centrifuging for 10 minutes the clear layer was poured off and again centrifuged, and this procedure was repeated four times, the sediment from each centrifuging being examined microscopically.

**Method for the Investigation of Fossils by Serial Sections.†** — W. J. Sollas points out that the mechanical difficulties which preclude

* Roy. Soc. Rep. Sleeping Sickness Com., No. 1 (1903) 88 pp. (10 pls.).
† Proc. Roy. Soc., lxxii. (1903) p. 98.

the study of fossils by serial thin sections, may be obviated by means of serial polished surfaces obtained at any desired degree of proximity, and these when the fossil and its matrix offer sufficient optical contrast, serve most of the purposes of thin slices. They may be photographed under the Microscope so as to furnish a trustworthy and permanent record. The sections, which are obtained at intervals of about 0·025 mm., may be also used for reconstructing the fossil in wax.

**Application of the Cinematograph Principle to the Study of Serial Sections.**—B. E. Kelly.* The tissue is fixed, stained in bulk and imbedded in paraffin. The most convenient width of the paraffin block was found to be three-eighths of an inch. A ribbon is cut, floated on to warm water, and then stuck on to a celluloid film by means of an albuminate fixative. When dry, the paraffin is dissolved in xylol, and the sections are fixed to the film by means of a varnish. A French oil-varnish has been hitherto used. When thoroughly dry, the film is rolled up and placed in a cinematograph apparatus, and the sections are projected on a screen by means of a camera ; or the working portion of the cinematograph camera is placed on the stage of a microscopic projection apparatus, or even on the stage of an ordinary Microscope. The advantages claimed by this method are :

1. The ease with which a series of sections can be demonstrated to an audience.

2. The unique impression of continuity.

**Simple Method of Making Collodion Sacs for Bacteriological Work.**†—W. D. Frost uses small test-tubes for this purpose. Thick collodion is poured into the tube to a depth equal to the desired length of the sac. It is then poured out along one side of the tube into another, and then again into another in the same way. The coated tubes are then placed mouth downwards in a rack to drain off excess and to dry. When dry, the sac usually shrinks and may be easily pulled out. The sacs may be kept a long time in water. To sterilise the sac it is three parts filled with bouillon or other medium, and immersed in a tube of the medium. The sac is held in position in the tube by means of the tongue formed by the collodion flowing out of the tube. Before the sac is put in the tube, a piece of cotton or silk is placed round its upper part and loosely knotted, the ends being taken outside the tube. Sterilisation is then effected in the usual way. The medium in the sac is then inoculated with a platinum needle, and the tube incubated for 24 hours. If at the end of this time the medium outside the sac be clear, the integrity of the latter may be accepted. The sac is then pulled out and the cotton or silk drawn tight and tied, and the ends cut off along with the ends of the sac. The mouth is finally sealed with collodion. The sac is then ready for introduction into the body cavity of an animal.

The advantages claimed are : (1) Simplicity ; (2) No danger from air bubbles ; (3) May be made of any size or shape ; (4) No glass to break or irritate the animal ; (5) Maximum amount of dialysing surface.

* Brit. Med. Journ., ii. (1903) pp. 313–4.

† Centralbl. Bakt. I^te^ Abt. Orig., xxiv. (1903) pp. 733–5.

**Bottle for Immersion Oil.***—A. Schuberg describes a bottle for immersion oil made by W. and H. Seibert of Wetzlar. The neck of the bottle is prolonged upwards into a funnel-shaped expansion, the diameter of which equals that of the bottle itself. The outer edge of this expansion is ground for the reception of a bell-shaped glass capsule. The glass stopper is prolonged downwards into a thin rod, nearly reaching the bottom of the bottle, and ending in a small pear-shaped head. The stopper possesses three deep vertical grooves which permit any excess of oil to run back into the bottle. The advantages claimed are: the oil can be removed without the bottle becoming smeared, and soiling of the grip of the glass rod, etc. is avoided; the quantity used can be easily regulated; all parts can be easily cleaned; and the bottle can be carried about full.

**A Modification of the Pantograph for the Drawing of Microscopical Preparations.**†—F. V. Friedländer has designed a modification of this instrument, in which the angle of the parallelogram, carrying the guiding-pin, is not, as in the stork's-bill, a solid vertical axis, but is a ring-joint of the two limbs of the parallelogram which here meet. This ring is 44 mm. in diameter, and its centre corresponds to what would have been the crossing of the two limbs. It is thus possible to view from above the preparation to be drawn. The guiding pin which follows the contour of the preparation, passes obliquely downwards from one of the limbs of the parallelogram to its position under the ring. Its position can be altered and fixed with a screw, to suit objects of different thickness; the point, however, is always directly under the centre of the ring. The ring is adapted for the reception of a drawing Microscope. The whole apparatus is fixed with a screw to a drawing board, which, for the use of transmitted light with the Microscope, has a piece cut out and covered with glass. The apparatus gives an enlargement of 2–10 diam. The right hand guides the drawing point, while the eye, from above, controls the movement of the guiding point on the preparation.

## Metallography, &c.

**Micrographic Study of Cast Iron.**‡—The distribution of the impurities in cast iron offers many features of interest to the engineer. P. Longmuir has briefly examined some typical cast iron, and reproduces their characteristic structures. He gives a few notes on heat treatment for the production of "black heart" and malleable cast iron.

**Note on the Amphibole Hudsonite previously called a Pyroxene.**§ S. Weidman having made thin sections of hudsonite and placed them under the Microscope, it was seen by the prismatic cleavage of 56° and 124° and by the optical properties of low birefringence, strong pleochroism and absorption, that this mineral is an amphibole, and not

* Zeit. Wiss. Mikr., xx. (1903) pp. 17–20 (1 fig.).
† Tom. cit., pp. 12–4 (1 fig.).
‡ Page's Mag., iii. (1903) pp. 99–104 (8 figs.).
§ Amer. Journ. Sci., xv. (1903) pp. 227–32 (2 figs.).

a variety of pyroxene, as it had always been supposed. Cleavage fragments of the mineral measured by a hand goniometer also readily showed the prismatic cleavage to be that of amphibole.

FAY, H., HIGGINS, A. W., and COBURN, F. W.—**Study of the Relations between the Microstructure, the Heat Treatment, and the Physical Properties of Axle Steel.** *Technology Quarterly*, XVI. (March 1903) pp. 4-17, 15 figs.

BECKER, A.—**Krystalloptik. Eine ausführliche elementare Darstellung aller wesentlichen Erscheinungen, welche die Krystalle in der Optik darbieten, nebst einer historischen Entwicklung der Theorien des Lichtes.** Stuttgart, 1903. 362 pp. and 106 figs.